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A monograph of *Dryopteris* (Pteridophyta: Dryopteridaceae) in the Indian subcontinent

Christopher R. Fraser-Jenkins

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Christopher R. Fraser-Jenkins
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Synopsis

The genus *Dryopteris* is revised for the Indian subcontinent. Fifty-seven species are recognised and placed in subgenera and sections. Each is provided with a full description, together with details of cytology, ecology, range, and taxonomy. Nine hybrids are also treated in detail. All of the taxa are illustrated photographically. The following new species and hybrids are included: *Dryopteris austro-indica, D. caroli-hopei, D. darjeelingensis, D. himachalensis, D. khullarii, D. madrasensis, D. sledgei, D.* × *flemingii, D.* × *ghatakii, D.* × *liddarensis, D.* × *loyalii, D.* × *macdonellii, D.* × *vidyae, D.* × *wechteriana,* and *D.* × *zygo-parentalis*. Seven new combinations are made: *D. barbigera* subsp. *komarovii* (Kossinsky) Fraser-Jenkins, *D. blanfordii* subsp. *nigrosquamosa* (Ching) Fraser-Jenkins, *D. bonatiana* (Brause) Fraser-Jenkins, *D. deparioides* subsp. *ambigua* (Sledge) Fraser-Jenkins and subsp. *gracillima* (Ching) Fraser-Jenkins, *D. hirtipes* subsp. *atrata* (Kunze) Fraser-Jenkins, and *D. macrochlamys* (Fée) Fraser-Jenkins. *D. sri-lankensis* Fraser-Jenkins is a new name for *D. simulans* Ching. A key to the species (by subgenera and sections) and an annotated list of excluded taxa are given.

Introduction

A review of the classification of *Dryopteris* by Fraser-Jenkins (1986) gives some details of related genera and contains a new classification of the genus into four subgenera and sixteen sections, most of the world's species being placed within these. This classification is employed here. General information relevant to this monograph, such as the geographical areas used in the sections dealing with range in the Indian subcontinent, can be found in Fraser-Jenkins (1984).

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Dryopteris is one of the largest fern genera in the Indian subcontinent but, because of the complex array of species in the area (*c.* 48% are so far known to be polyploids and *c.* 41% to be apomicts) and the close relationships between them, it has not been catalogued or treated in modern studies beyond various local lists or preliminary local cytological reports. At present the three most complete accounts of the genus are those of Hope (1899–1904), which though unsurpassed in many respects is now very outdated; Ching (1938), which is most useful and generally accurate, though containing a number of superfluous species; and Mehra & Loyal (1965), which is the only modern account but is somewhat incomplete and sometimes inaccurate as far as identification is concerned. None of the more recent works takes into account the full range of Himalayan species which also occur in China, Taiwan, etc., and in consequence the nomenclatural situation is often unclear. In addition, very few local botanists know the species of *Dryopteris*, either in the field or in the herbarium, mainly because of their complexity. It is therefore hoped that the present monograph will help to cast more light on the genus.

Dryopteris contains approximately 225 species (Fraser-Jenkins, 1986), though markedly higher numbers have recently been suggested by Ching (1982 pers. comm.) due to a much narrower and more artificial species concept. Doubtless some of the complex groups still to be revised (in China, etc.) will prove to contain more species as work continues.

The centre of the genus is undoubtedly in the Sino-Himalayan region of west China (including SE. Tibet, Yunnan, and Szechuan), the east Himalaya, and north Burma, with *c.* 76 species present. There are about 102 species (18 endemic) in mainland China, and 57 (13 endemic) in the Indian subcontinent. Unfortunately the fern flora of north Burma and the far east Indo-Himalaya (Arunachal Pradesh, etc.) is virtually unknown due to political restrictions on visiting the area, and is likely to remain so. However, judging from the large collections in Chinese herbaria, recently made in Yunnan Province, south-west China, it is certain that north Burma, etc. must contain a very rich fern flora, and if careful collections were ever to be made at higher altitudes in Arunachal Pradesh, it seems likely that a number of Chinese species of *Dryopteris* would be added to the list for the Indian subcontinent.

At present the far east Himalayan fern flora is effectively unknown to Indian botanists and largely ignored; only the collections of Ludlow and Sherriff, and Kingdon-Ward cover the area in any detail, and these are not known to Indian pteridologists, who themselves cannot collect at higher altitudes in the east Himalaya or in Arunachal Pradesh.

Three other areas whose floras are closely associated with that of the Sino-Himalayan region are Taiwan, with *c.* 40 species (3 endemic); Japan, though to a lesser extent, with *c.* 59 species (12 endemic); and, to a lesser extent still, south-east Asia, including the Philippines and the Malaysian archipelago, with *c.* 32 species (5 endemic). In contrast to these rich areas, North America has only 16 species (6 endemic) and Europe in the wide sense (Macaronesia and north-western Africa to western Asia and central Siberia) only 26 species (18 endemic).

A brief analysis of the 57 species from the Indian subcontinent reveals the following numbers of those which also occur in other parts of the world: China (including Tibet) – 44, Taiwan – 21, south-east Asia – 15, Japan – 6, Australasia and the Pacific islands – 3, other regions – 2 (the widespread species, *D. filix-mas* and *D. wallichiana*), Europe (sens. lat.) – 1.

There are 14 endemic species in the present area, eight being south Indian or Sri Lankan, four west Himalayan, and two east Himalayan. The cytology of most of the species has been examined, at least preliminarily, though 11 are unknown cytologically; the known species consist of, or contain, 25 polyploids, 22 apomicts, and 24 diploids (17 sexual diploids and seven apomictic diploids). It is doubtful whether cytological figures can reveal any significant information about the antiquity or composition of the flora when compared with the figures from other areas. This is especially the case in this region where few other genera have been studied in detail, and where figures published so far are highly incomplete.

Key to species (by sections)

In *Dryopteris*, and probably in other fern genera with a high degree of interrelationship between species and variation within species, single characteristics which are reliable or normally reliable

for differentiation of the species do not exist. Nevertheless, many attempts have been made to detail and use such characteristics, usually with the result that workers have unduly narrow concepts of what features the species should possess and cannot identify more than about half of the specimens before them.

The main aids to identification provided in this paper are probably the photographs, combined with a perusal of the descriptions. Each photograph shows a pair (where possible) of lower median pinnae, or sometimes the lowest pair of pinnae, usually seen from the top side. In the author's opinion even the large amount of repetitive key required to allow the identification of a reasonable percentage of specimens comes nowhere near the usefulness of photographs as a means of rapid recognition of species. However, a key is given to the species within each section. It has not been possible to produce a key to the sections as each contains a number of species that vary (in any parameter) so as to make even a general description of the section inapplicable in many instances, though the species clearly form natural assemblages which are separate from one another.

When identifying specimens it should be remembered that hybrids may occur between species (except when both suspected parental species are apomicts, as at least one sexually reproducing species has to be involved). In order to recognise these and avoid the confusion that their intermediate morphology can cause, it is advisable to examine samples of ripe spores microscopically, as described by Fraser-Jenkins (1984).

Subgenus 1. Dryopteris

Bullate scales absent, fronds not imparipinnate, segments usually symmetrical and without auricles at the acroscopic base; pinnulet arrangement catadromous.

Section 1. Hirtipedes

Fronds once pinnate, lanceolate to narrowly lanceolate, pinnae lobed to only half their depth or less except at the very base of the lowest few pinnae; stipe and rachis scales mostly narrow and dark.

1a	Sori entirely exindusiate even when young	**1. D. scottii** (p. 330)
1b	At least some sori with indusia (though in old specimens where many have dropped off, careful search may have to be made with a lens)	2
2a(1b)	Sori marginal or submarginal, veins slightly darkened and impressed into the lamina	**5. D. dickinsii** (p. 337)
2b	Sori near the costa or distributed throughout the pinna, veins neither darkened nor impressed	3
3a(2b)	Stipe scales all narrow and ± uniform (very slightly widening to the base)	4
3b	Stipe bearing mixed narrow and wider lanceolate scales	6
4a(3a)	Pinnae shallowly lobed or ± unlobed, lobes, if present, closely juxtaposed	**4. D. stenolepis** (p. 336)
4b	Pinnae lobed to half their depth and more deeply at the bases of the lower few pinnae, lobes becoming slightly separated at least at their apices	5
5a(4b)	Stipe and rachis bearing somewhat scattered, black, ± adpressed scales, lobe edges and teeth hard and stiff	**6. D. lunanensis** (p. 339)
5b	Stipe and rachis densely clothed with mid- or grey-brown, spreading scales, lobe edges and teeth ± lax	**7. D. conjugata** (p. 341)
6a(3b)	Stipe base bearing slightly wider lanceolate scales than the upper stipe, pinnae ± narrow and slightly crowded, sori bearing minute, vestigial indusia	**3. D. darjeelingensis** (p. 335)
6b	Stipe base bearing markedly wider ovate-lanceolate scales than the upper stipe, pinnae ± wide and well spaced, sori bearing normal-sized indusia	**2. D. hirtipes** (p. 332)

Section 2. Fibrillosae

Stipe and rachis usually ± densely scaly, scales predominantly narrow, ± brown or black; fronds once pinnate, a second time deeply pinnatifid, or becoming twice pinnate below, lanceolate to narrowly lanceolate; lamina ± coriaceous and somewhat glossy above; pinna-lobes or pinnules parallel-sided and ± rectangular, with truncate or rounded-truncate apices.

1a	Stipe scales abruptly lanceolate, partly deciduous	**12. D. acuto-dentata** (p. 350)
1b	Stipe scales mostly, or all, narrowly lanceolate, persistent	2

2a(1b) Stipe and rachis scales predominantly brown, at least on the rachis (though varying in shade) 3
2b Stipe and rachis scales all black or dark blackish-brown 7

3a(2a) Pinna-lobes or pinnules small (*c.* 7 × 2·5 mm), lamina slightly glossy above, bearing somewhat numerous, hair-like fibrillae .... **10. D. redactopinnata** (p. 346)
3b Pinna-lobes or pinnules large (*c.* 8–13 × 4–5 mm), lamina considerably glossy above, bearing very few, if any, hair-like fibrillae 4

4a(3b) Pinna-lobes or pinnules in the lower part of the frond lobed up to about half their width on each side, the lower basiscopic ones well developed and longer than those above **17. D. khullarii** (p. 362)
4b Pinna-lobes or pinnules not, or only very slightly, lobed, the lower basiscopic ones not more developed, or only very slightly longer than those above 5

5a(4b) Pinnae not, or only very slightly, tapered below so that the base of the lamina is widely truncate; scales all markedly linear (though gradually becoming slightly wider at the stipe base) ..... **13. D. lepidopoda** (p. 352)
5b Pinnae tapered below so that the base of the lamina is narrow or slightly truncate; stipe-base scales lanceolate but not markedly linear, those above narrower 6

6a(5b) Lowest pinnae slightly developed on their basiscopic side, pinna-lobes in the mid-upper pinnae joined at their bases by a somewhat wide wing of tissue, their apices rounded-truncate or slightly obtusely pointed ..... **15. D. madrasensis** (p. 359)
6b Lowest pinnae not at all developed on their basiscopic side, pinna-lobes in the mid-upper pinnae joined at their bases only by a very narrow wing of tissue, their apices truncate or truncate with rounded corners ..... **14. D. wallichiana** (p. 354)

7a(2b) Upper stipe and rachis bearing only scattered scales ..... **16. D. sledgei** (p. 361)
7b Upper stipe and rachis densely scaly 8

8a(7b) Pinna-lobes or pinnules small (*c.* 5–10 × 2–3 mm), lamina slightly glossy above, bearing somewhat numerous, hair-like fibrillae 9
8b Pinna-lobes or pinnules somewhat large (*c.* 8–13 × 4–5 mm), lamina considerably glossy above, bearing very few, if any, fibrillae 10

9a(8a) Lamina markedly narrowly tapered below, stipe short ..... **8. D. pulcherrima** (p. 342)
9b Lamina not, or only slightly, tapered below, stipe long ..... **11. D. yigongensis** (p. 348)

10a(8b) Pinna-lobes or pinnules in the lower part of the frond lobed up to about half their depth on each side, the lower basiscopic ones well developed and longer than those above **17. D. khullarii** (p. 362)
10b Pinna-lobes or pinnules not, or only very slightly, lobed, the lower basiscopic ones not developed, or only very slightly longer than those above 11

11a(10b) Pinnae not, or only very slightly, shorter below so that the base of the lamina is widely truncate; scales all markedly linear (though gradually becoming slightly wider at the stipe base) ..... **13. D. lepidopoda** (p. 352)
11b Pinnae shorter below so that the base of the lamina is narrow or only slightly truncate; stipe-base scales lanceolate or somewhat widely lanceolate, those above considerably narrower 12

12a(11b) Stipe and rachis scales castaneous-black, most of those on the rachis short, lanceolate and somewhat scattered ..... **9. D. neorosthornii** (p. 345)
12b Stipe and rachis scales not castaneous-black, those on the rachis long, linear and dense ... 13

13a(12b) Lowest pinnae slightly developed on their basiscopic side, pinna-lobes in the mid-upper pinnae joined at their bases by a somewhat wide wing of tissue, their apices rounded-truncate or slightly obtusely pointed ..... **15. D. madrasensis** (p. 359)
13b Lowest pinnae not at all developed on their basiscopic side, pinna-lobes in the mid-upper pinnae joined at their bases only by a very narrow wing of tissue, their apices truncate or truncate with rounded corners ..... **14. D. wallichiana** (p. 354)

Section 3. Pandae

Fronds once pinnate to a second time pinnatifid, or twice pinnate, lanceolate to narrowly lanceolate; stipe bearing somewhat scattered, usually pale and lanceolate, or ovate-lanceolate scales, rachis usually ± devoid of scales, or bearing only scattered scales; lamina pale green, somewhat succulent-herbaceous in

texture; pinna-lobes or pinnules usually with wide, obtuse, or ± rounded-truncate apices. Indusia usually large, spores usually large and somewhat reddish-brown.

1a Pinnae lobed only to approximately half their depth, or a little more at the base of the lowest pinna 2
1b Pinnae deeply pinnatifid or pinnate 4
2a(1a) Lower rachis and upper stipe bearing ± dark, linear-lanceolate scales **21. D. woodsiisora** (p. 368)
2b Lower rachis and upper stipe ± devoid of scales 3
3a(2b) Pinna-lobes truncate; sori very large (2–2·5 mm diam.) and close to the pinna midrib **18. D. bonatiana** (p. 363)
3b Pinna-lobes mostly rounded, or rounded-truncate, except in the upper pinnae, where rounded; sori medium-sized (1·5–2 mm diam.), spreading slightly up the pinna-lobes **19. D. panda** (p. 365)
4a(1b) Lamina somewhat crispaceous, with long-acute, ± stiff teeth, lowest pinnae the largest and their lowest basiscopic pinnules developed and usually curved towards the pinna-apex ..... **24. D. nobilis** (p. 374)
4b Lamina slightly succulent-herbaceous with ± obtuse, herbaceous teeth or crenations, lowest pinnae not the longest and their lowest basiscopic pinnules usually shorter than the next and not developed or curved 5
5a(4b) Scales on the upper stipe and lower rachis mostly dark; pinna-lobes or pinnules with the sori ± widely spaced and submarginal ..... **21. D. woodsiisora** (p. 368)
5b Scales on the upper stipe and lower rachis pale, or mid-brown; pinna-lobes or pinnules with crowded sori ± near the pinnule midrib 6
6a(5b) Stipe-base scales predominantly mid-brown; indusia not all completely enclosing the sorus; ripe spores irregular and admixed with abortive spores **20. D. himachalensis** (p. 367)
6b Stipe-base scales predominantly pale; indusia all completely enclosing the sorus; ripe spores regular 7
7a(6b) Stipe as long as the lamina, lamina compact, ovate-lanceolate (S. India) **22. D. austro-indica** (p. 370)
7b Stipe shorter than the lamina, lamina compact or lax, lanceolate (Himalaya) **23. D. chrysocoma** (p. 371)

Section 4. Dryopteris

Fronds twice pinnate, usually lanceolate; stipe bearing mostly lanceolate, or ovate-lanceolate, scales; lamina mid- or pale green, herbaceous; pinnules mostly ± adnate or widely attached to the costae, unlobed, or ± shallowly lobed, usually with rounded or pointed apices, not usually markedly parallel-sided (unlike section *Fibrillosae*). Indusia ± small.

1a Lamina bearing numerous scattered fibrillae, stipe and rachis ± densely scaly **28. D. barbigera** (p. 380)
1b Lamina ± without fibrillae, upper stipe bearing ± scattered scales, rachis with few or no scales 2
2a(1b) Frond large (*c.* 60–100 cm long), lower stipe somewhat densely scaly with mixed lanceolate and narrow scales; pinnule teeth ± shortly acute ..... **25. D. filix-mas** (p. 375)
2b Frond small (*c.* 10–35 cm long), stipe bearing scattered ovate-lanceolate scales; pinnule teeth long and markedly aristate 3
3a(2b) Lamina ovate-lanceolate, thin, densely glandular mainly on the axes, segments with long splayed-out teeth ..... **27. D. alpestris** (p. 380)
3b Lamina elongated triangular-lanceolate, ± thick, bearing ± scattered glands, segments with short, unsplayed teeth ..... **26. D. serrato-dentata** (p. 377)

Section 5. Remotae

Intermediate between sections *Fibrillosae* and *Marginatae*; fronds twice pinnate, somewhat narrowly lanceolate, or narrowly triangular-lanceolate, with a truncate base; stipe long, stipe and rachis densely scaly with dark scales, those on the stipe being markedly ovate-lanceolate, becoming narrower above and mixed with fibrillae; pinnules shallowly lobed and ± parallel-sided, usually becoming developed and deeply lobed below, lobes rectangular; lamina herbaceous. Indusia small, somewhat thick. A single species in the Indian subcontinent ..... **29. D. blanfordii** (p. 386)

Section 6. Pallidae

Fronds twice-pinnate, often a third time pinnatifid, elongated triangular-lanceolate; stipe long, bearing ovate-lanceolate scales at the base, which often become very scattered, or ± absent, on the rachis; lamina somewhat crispaceous-herbaceous and often slightly glaucous above, pinnules with rounded or pointed apices and usually ± rectangular side-lobes, lower pinnules on each pinna stalked. Indusia small or large.

1a Scales towards the base of the stipe mostly, or all, very dark castaneous or blackish 2
1b Scales towards the base of the stipe mostly, or all, brown 6

2a(1a) Upper stipe and rachis ± densely scaly (though scales partly deciduous on drying); indusia large and thick ..... **30. D. sublacera** (p. 389)
2b Upper stipe and rachis with few or no scales, indusia small and not markedly thick 3

3a(2b) Pinnules with markedly cordate and bi-auriculate bases, sori submarginal (S. India only) **31. D. odontoloma** (p. 391)
3b Pinnules with non-cordate, or only very slightly cordate, non-auriculate bases, sori near the centre, or medial (N. and S. India) 4

4a(3b) Mid-stipe scales brown, basal pinnules markedly longer than those above on the same pinna; pinnae foliose ..... **34. D. stewartii** (p. 398)
4b Mid-stipe scales blackish, basal pinnules slightly but not markedly longer than those above on the same pinna; pinnae not foliose 5

5a(4b) Lamina mid-green above, pinnules with wide, markedly rectangular lobes when lobes present, pinnule-apices wide, rounded, or rounded-truncate, except for those on the lowest pinnae in well-developed plants, which are pointed ..... **32. D. juxtaposita** (p. 393)
5b Lamina blue-green above, pinnules with ± narrow, rounded-truncate lobes, pinnule-apices narrow, rounded or pointed ..... **33. D. nigropaleacea** (p. 396)

6a(1b) Pinnules with markedly cordate and bi-auriculate bases; sori submarginal, indusia not markedly large (up to *c.* 1 mm diam.) ..... **31. D. odontoloma** (p. 391)
6b Pinnules with non-cordate, or very slightly cordate, and non-auriculate bases; sori not submarginal, indusia markedly large (*c.* 1·2–1·7 mm diam.) and taller 7

7a(6b) Scales matt with markedly minutely-fimbriate or minutely-toothed edges, lamina not glossy above, pinnules slightly sloping to a rounded or obtusely-pointed apex **30. D. sublacera** (p. 389)
7b Scales glossy with edges bearing only a few, or no, fimbriations, lamina somewhat glossy above, pinnules not sloping to their rounded, or rounded-truncate, apices 8

8a(7b) Lamina pale green, pinnules few per pinna, markedly wide, with markedly rounded-truncate apices, pinnule-teeth ± few and somewhat short ..... **35. D. lachoongensis** (p. 400)
8b Lamina dark green, pinnules many per pinna, not markedly wide, with rounded apices, pinnule-teeth many and long ..... **36. D. fructuosa** (p. 402)

Section 7. Splendentes

Fronds twice pinnate, often becoming a third time deeply pinnatifid, lanceolate; stipe long; pinnules narrowly attached except in the upper parts of the pinnae, markedly asymmetrical at their bases, the lobes on their basiscopic sides being narrower and more obliquely inserted than those on their acroscopic sides, but pinnules not, or hardly, auriculate at their acroscopic bases.

1a Stipe and lower rachis glossy black, bearing scattered, small, adpressed, lanceolate, matt, brown scales; pinnules bearing wide contiguous lobes ..... **37. D. splendens** (p. 405)
1b Stipe and lower rachis pale green (reddish towards stipe-base), bearing somewhat dense, large, spreading, ovate or ovate-lanceolate, glossy black scales; pinnules bearing very narrow, well-separated lobes ..... **38. D. sikkimensis** (p. 407)

Section 8. Marginatae

Fronds large, bipinnate or more usually tripinnate, occasionally becoming a fourth time pinnate, usually widely triangular-lanceolate; stipe long, bearing scales at the base which become very small and scattered, or absent further up; pinnules usually narrowly attached to the costae, symmetrical, ultimate lobes somewhat distant, teeth without hair-points; lamina herbaceous. Indusia usually thin. Spores without minute spinules.

1a Fronds markedly dimorphic, fertile ones markedly compact and with very crowded sori **39. D. cochleata** (p. 408)

1b Fronds non-dimorphic, fertile ones not compact and sori not markedly crowded 2

2a(1b) Lamina lanceolate and usually slightly narrowed at the base 3
2b Lamina widely triangular-lanceolate, widest at the base 4

3a(2a) Fronds arising together from the rhizome apices, pinnules ranging from ± unlobed to pinnatifid, patent ..... **40. D. pteridiiformis** (p. 412)
3b Fronds arising from the rhizome at intervals, pinnules pinnate, markedly upright **41. D. angustifrons** (p. 413)

4a(2b) Pinnules mostly lobed or pinnatifid, becoming pinnate only near the base of the lamina; indusia persistent, somewhat thick, becoming reddish-brown **42. D. subimpressa** (p. 415)
4b Pinnules mostly pinnate throughout the lamina; indusia thin, ± fugacious, becoming pale- to mid-brown 5

5a(4b) Lamina finely dissected, ultimate segments narrow and markedly acutely pointed, with markedly long-acute teeth ..... **46. D. ramosa** (p. 425)
5b Lamina coarsely dissected, ultimate segments wide, rectangular, rounded or obtusely pointed, with ± short-acute teeth 6

6a(5b) Pinnae and pinnules closely sessile so that the pinnules or pinnulets are markedly closely juxtaposed to the rachis or pinna-costae respectively; pinnules with caudate, ± unlobed apices (S. India and Sri Lanka) ..... **43. D. approximata** (p. 419)
6b Pinnae and pinnules shortly stalked and not closely sessile; pinnules without caudate, unlobed apices (Himalaya) 7

7a(6b) Lamina markedly smooth on the upper surface, ultimate segments mostly ± rectangular (but can be pointed in the lower parts of the lamina), with ± insignificant teeth; stipe-base scales glossy and exserted (E. Himalaya only) ..... **44. D. marginata** (p. 420)
7b Lamina matt, with impressed veins on the upper surface, ultimate segments pointed, with marked teeth; stipe-base scales matt and adpressed (W. and E. Himalaya) **45. D. caroli-hopei** (p. 422)

Subgenus 2. Erythrovariae (Sections Erythrovariae and Variae)
Stipe-scales mostly confined to the base of the stipe (except in *D. varia*), stiff and narrow; fronds not imparipinnate, segments symmetrical or asymmetrical, bearing small, bullate, or sack-like scales on the pinnule midribs and tips of the pinna-costae on the under surface (except in *D. assamensis*, and only weakly bullate ones present in *D. varia*); pinnulet arrangement catadromous; species confined to the E. Himalaya.

1a Frond lanceolate or ± linear-lanceolate, pinnules markedly rectangular though often slightly narrowed to their bases, bullate scales absent ..... **47. D. assamensis** (p. 428)
1b Frond widely triangular-lanceolate or deltate, pinnules not markedly rectangular, bullate scales present (though only weakly bullate in *D. varia*) 2

2a(1b) Upper stipe glabrous, lowest basiscopic pinnule on the lowest pinna not markedly longer than those above, pinnule-apices not caudate, rounded ..... **48. D. subtriangularis** (p. 430)
2b Upper stipe bearing many small scales, lowest basiscopic pinnule on the lowest pinna markedly the longest, pinnule apices caudate and acutely pointed ..... **49. D. varia** (p. 432)

Subgenus 3. Nephrocystis (Sections Purpurascentes and Nephrocystis)
Stipe-scales mostly confined to the stipe-base, either very narrowly linear, or lanceolate to ovate; fronds not imparipinnate, triangular-lanceolate, segments markedly asymmetrical and sloping and usually bearing a ± rounded auricle at their acroscopic base; pinnulet arrangement at the base of the frond anadromous or catadromous; lamina markedly smooth.

1a Scales confined to a tuft of long, very narrowly linear ones at the very base of the stipe, with minute ones appearing almost like pubescence on the rachis, particularly where the pinna-costae join it ..... **50. D. pulvinulifera** (p. 434)
1b Scales ovate or lanceolate, extending slightly up the lower stipe; rachis ± glabrous 2

2a(1b) Rachis ± straight, pinnae not deflexed 3
2b Rachis markedly zig-zagged, pinnae backward-deflexed 8

3a(2a) Scales ovate and bicolorous with a darker central area 4
3b Scales lanceolate and concolorous 5

4a(3a) Frond coarsely dissect and segments large, stipe pale or green ..... **52. D. sparsa** (p. 438)
4b Frond somewhat finely dissect and segments small, stipe reddish-purple **53. D. yoroii** (p. 442)

5a(3b) Scales very dark brown or blackish, ultimate segments markedly rounded **51. D. hasseltii** (p. 436)

5b Scales pale- to somewhat russet-brown, ultimate segments ± lanceolate 6

6a(5b) Pinnae markedly linear and mostly opposite, pinnae and pinnules markedly closely sessile, basal pinnules opposite ..... **55. D. sri-lankensis** (p. 451)

6b Pinnae ± narrowly triangular-lanceolate, becoming alternate in the middle of the frond, pinnae and at least the lower pinnules with short stalks and not markedly sessile, pinnules alternate 7

7a(6b) Segments markedly obtuse and large (*c.* 12 × 25 mm) ..... **56. D. macrochlamys** (p. 453)

7b Segments ± pointed, not markedly obtuse or large (*c.* 7 × 15 mm) **54. D. deparioides** (p. 445)

8a(2b) Lamina up to four times pinnate, stiff, all segments crowded .... **56. D. macrochlamys** (p. 453)

8b Lamina up to five times pinnate, lax, all segments well-spaced ..... **57. D. diffracta** (p. 456)

Species

Dryopteris Adans., *Fam. pl.* 2: 20, 551 (1763), nom. cons.

Subgenus 1. Dryopteris

Section 1. Hirtipedes Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 190 (1986).

1. Dryopteris scottii (Beddome) Ching ex C. Chr. **Fig. 1**

in *Bull. Dep. Biol. Coll. Sci. Sun Yatsen Univ.* **6**: 3 (1933). – *Polypodium scottii* Beddome, *Ferns Brit. India* **2**: 345, pl. 345 (1870). – *Phegopteris scottii* (Beddome) Beddome, *Suppl. ferns S. Ind.*: 19 (1876). – *Dryopteris scottii* var. *scottii* in Tagawa, *Acta phytotax. geobot. Kyoto* **15** (1): 14 (1953). Type: 'Lately discovered by Mr. J. Scott in the valley of the Rungio [Rungit, Darjeeling] (elevation 2,000 feet), near the Govt. Cinchona Gardens' (?CAL).

Nephrodium hirtipes (Blume) Hook. var. *exinvolucrata* C. B. Clarke in *J. Linn. Soc.* (Bot.) **25**: 93 (1889), nom. nov. for *Polypodium scottii* Beddome. – *Dryopteris hirtipes* var. *exinvolucrata* (C. B. Clarke) Panigr. & S. K. Basu in *Proc. Indian Sci. Congr.* **69** (3, 6): 71 (1982).

Phegopteris grossa Christ in *Bull. Herb. Boissier* **7**: 13 (1899). – *Dryopteris grossa* (Christ) C. Chr., *Index filic.*: 269 (1905). Type: China, Yunnan, Mengtze, Su Pu Ti, gulley, on rock in ravine, *A. Henry* 11588 (K! – holotype).

Phegopteris melanolepis Alderw. in *Bull. Jard. bot. Buitenz.* II, **16**: 25 (1914). Type: Sumatra, Gunung Singgalan, 4500 ft, 6 February 1912, *C. G. Matthew* 522 (L! – lectotype, selected here; K! – isolectotypes).

Dryopteris nigrisquama Hayata, *Icon. pl. formos.* **4**: 167, fig. 106 (1914). – *Dryopteris nigrisquama* forma *typica* H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 16 (1939 ['1938']), nom. inval. (Art. 24.3). Type: Taiwan, Mt. Arisan, [January] 1912, *B. Hayata* [*& S. Sasaki*] (TI! – holotype).

Dryopteris subdecipiens Hayata, *Icon. pl. formos.* **4**: 181, fig. 119 (1914). – *Dryopteris nigrisquama* forma *subdecipiens* (Hayata) H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 16 (1939 ['1938]). Type: Taiwan, Arisan, [January] 1912, *B. Hayata* [*& S. Sasaki*] (TI! – holotype).

Fronds medium-sized (up to *c.* 95 cm long). Stipe as long as the lamina; stipe base bearing narrowly lanceolate, black scales which gradually become narrower, shorter, scattered and ± adpressed further up; rachis bearing very sparse, adpressed, small, very narrow, but not hair-like, black scales. Lamina once-pinnate, broad (up to *c.* 30 cm wide), with a broad base, ± dark green above, bearing few (up to *c.* 15 pairs) well-spaced, wide, glabrous, herbaceous and somewhat glossy pinnae, which become markedly fused above to form a wide, lobed lamina-apex; pinnae with a wide basal region, somewhat lanceolate and widest in the middle, lobed, at least the lobes on the lowest pinnae being noticeably rounded, particularly on the basiscopic sides of the pinnae, and the lower lobes sometimes somewhat extended, lower lobes usually ± without teeth except for one or two at their acroscopic corner. Sori completely exindusiate even at an early stage. Spores regular.

Cytology: Tetraploid sexual (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimen, *D. S. Loyal* 731, etc. (PAN 2103, 2104, etc.!). Gibby (1985). Taiwan: Kurita (1966), Mitui (1968), Tsai & Shieh (1975)). Hirabayashi (1970) reports it as an apomictic diploid from Taiwan but further investigation of his report is needed.

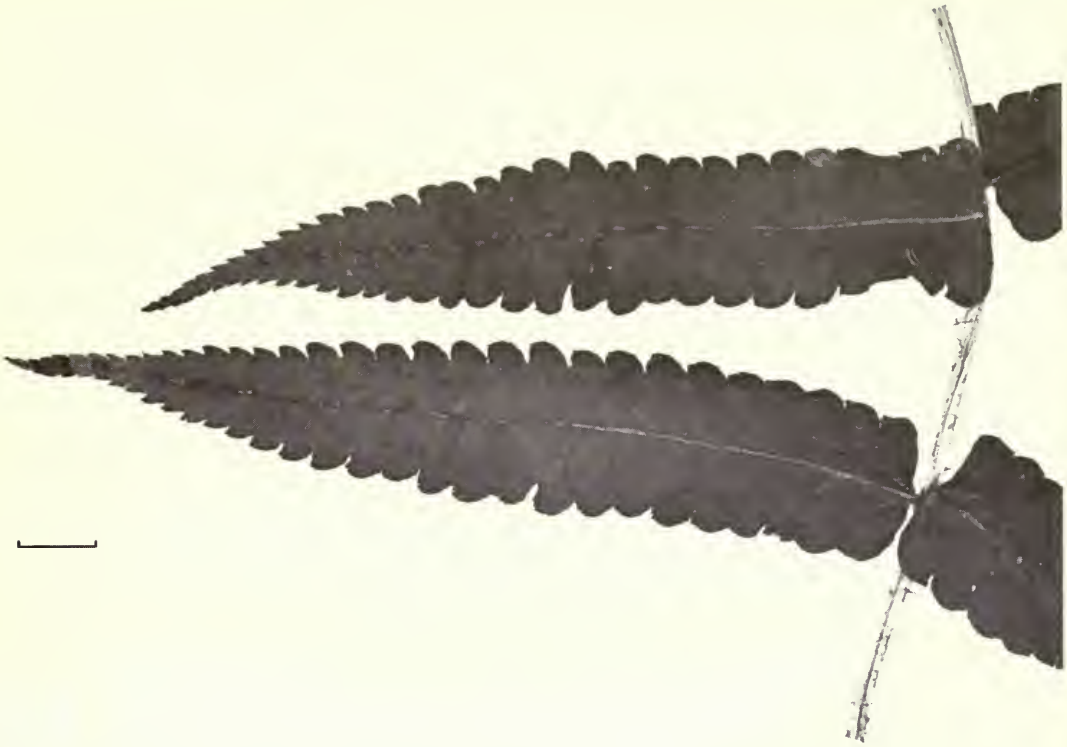

Fig. 1 *Dryopteris scottii.* India, West Bengal, Darjeeling, Lopchu, 19 October 1980, *C. R. Fraser-Jenkins* 10293 (BM). Scale line = 1 cm.

Ecology: A species of lower mid-level forests, growing on the forest floor, from *c.* 900–2000 m alt.

Range: India (E. Himalaya in Sikkim; Assam); Bhutan; SE. Tibet; China (Yunnan, Szechuan, Kweichow, Kiangsi, Hunan, Kwangsi, Kwangtung, Fukien, Chekiang, Hainan); Taiwan; probably S. Japan (recently reported by Kurata & Kato in Heki (1972) from Kagoshima, Kyushu); Burma; Thailand; Malaya (uncommon); N. Vietnam; Sumatra; Borneo. Apparently not yet collected in E. Nepal. A south-east Asian element.

*Range in the Indian subcontinent**: **64** Lopchu, Darjeeling, 19 October 1980, *C. R. Fraser-Jenkins* 10293 (BM!), 10289–10292, 10294–10296 (H!); **65** Sikkim, February 1881, *H. C. Levinge* (K!); **67** Mischichen (1400 m) to Khosa (1600 m), 10 May 1967, *H. Kanai et al.* 13789 (BM!, TI!); **75** Subansiri, sub *D. hirtipes*, with *D. stenolepis* (CAL!); **79** Borsilla [= Barsala, nr Jorhat], 1874, '*A soldier*' (BM!); **80** Maothana, February 1906, *M. Buysman* 2937 (L!); **83** Khasia, *J. D. Hooker & T. Thomson* (K!).

Notes: The author has been unable to locate the type cited and illustrated by Beddome. The species concepts of most earlier authors are too wide to permit separation of *Dryopteris scottii* in the section *Hirtipedes*, though Beddome recognised it at an early date, purely from its exindusiate sori. More recently Sledge (1973) has sunk it into *D. hirtipes* as he observed no differences between them, other than the exindusiate sori. However, its consistently distinctive morphology shows that it is a different species, as treated by Ching (1938). Some of the difficulty in distinguishing it results from confusion with old specimens of *D. hirtipes* where the indusia may have mostly dropped off, but careful search for indusia and examination of the scales will facilitate its recognition.

* Only one specimen has been cited as a voucher for each area, except in cases where it has been judged of interest to include more than one, e.g. where the taxon is rare.

D. scottii and *D. liankwangensis* Ching, from China and N. Vietnam, are probably the members of subgenus *Dryopteris* closest to the related subgenus, *Pycnopteris* (T. Moore) Ching, and it may be significant that both species are exindusiate and that another exindusiate species, *D. bodinieri* (Christ) C. Chr., from China, belongs to *Pycnopteris*. The very few other exindusiate species of *Dryopteris* are in quite different sections, such as *Marginatae*, and are not relevant here.

2. Dryopteris hirtipes (Blume) Kuntze

Revis. gen. pl. **2**: 813 (1891). – *Aspidium hirtipes* Blume, *Enum. pl. Javae*: 148 (1828). – *Lastrea hirtipes* (Blume) T. Moore, *Index fil.*: 94 (1858). – *Nephrodium hirtipes* (Blume) Hook., *Sp. fil.* **4**: 115, pl. 249 (1862). – *Dryopteris hirtipes* forma *typica* C. Chr. in *Contr. U.S. natn. Herb.* **26**: 278 (1931), nom. inval. (Art. 24.3). Type: Java, Gegar Bintang [Gede], *Blume* (L! – holotype; K! – isotype).

This species is divided here into two subspecies, both of which occur in the Indian subcontinent. They are morphologically very close, but can be recognised in most cases, and are cytologically distinct. The relationship between them has yet to be investigated.

2a. Dryopteris hirtipes subsp. **hirtipes** **Fig. 2**

Differs from subsp. *atrata* only in its considerably smaller size (fronds up to *c.* 60 cm long), smoother lamina with short, more crowded pinnae (up to *c.* 25 pairs), and its scales which are often more translucent and browner in colour. Spores regular.

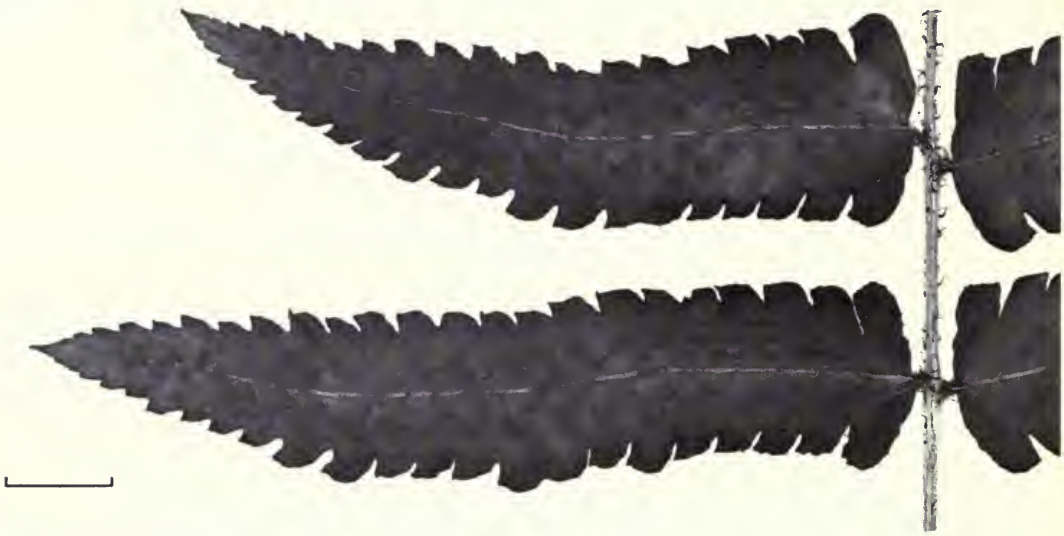

Fig. 2 *Dryopteris hirtipes* subsp. *hirtipes*. Sri Lanka, Hakgala Heights, 1951, *W. A. Sledge* P.192 (BM). Scale line = 1 cm.

Cytology: Diploid sexual (S. India: Bhavanandan (1981). Sri Lanka: Manton & Sledge (1954), voucher specimen, *W. A. Sledge* P.192, 1951 (BM!)).

Range: Sri Lanka; India (south); Malaya (uncommon); Sumatra; Java; Bali; Borneo; Sulawesi; Moluccas; New Guinea; Philippines; New Hebrides (Espiritu Santo); Fiji. A south-east Asian element.

Range in the Indian subcontinent: **95** Kodaikanal, Palni Hills (Bhavanandan, 1981); **100** Hakgala Heights, [1951], *W. A. Sledge* P.192 (BM!).

Notes: Christensen (1931) and Ching (1938) were the first to point out that *Dryopteris hirtipes* is the south Indian and Sri Lankan plant, while the plants from the Himalaya are different species (now referred to partly as *D. darjeelingensis* but mainly as *D. stenolepis*). As *D. hirtipes* (subsp.

atrata) was at that time little collected from the Himalaya, their treatments resolved the considerable confusion that existed due to the closeness of species in this section. More recently Ching (Mehra & Loyal, 1965) correctly reported a collection of *D. hirtipes* from the east Himalaya, where it is represented by subsp. *atrata*.

Sledge (1973) reported *D. hirtipes* from Samoa, in error for *D. fatuhivensis* E. Brown, which is probably a distinct species, also occurring in the Marquesas Islands.

2b. Dryopteris hirtipes subsp. **atrata** (Kunze) Fraser-Jenkins, **comb. nov.** **Figs 3–4**

Aspidium atratum Kunze in *Linnaea* **24**: 279 (1851), non Wallich (1828), nom. nud. (Art. 32.1). – *Nephrodium atratum* (Kunze) Hand.-Mazz., *Symb. sin.* **6**: 23 (1929). – *Dryopteris hirtipes* var. *atrata* (Kunze) C. Chr. in *Contr. U.S. natn. Herb.* **26:** 278 (1931). – *Dryopteris atrata* (Kunze) Ching in *Sinensia, Shanghai* **3**: 326 (1933). Types: S. India, *Schmid & Koch* 10, 25, 91, 147; *Kurr* 21; *Weigle & Schaeffer* 26 (LZ – syntypes, destroyed [B, BM, K, L, P – not present]).
Misapplied name: Dryopteris costalisora sensu Itô, Tagawa & Iwatsuki (1966, 1971).

Fronds medium-sized or large (up to *c.* 160 cm long). Stipe *c.* ½ as long as the lamina, somewhat fragile in the living state, stipe-base bearing wide, ovate-lanceolate to lanceolate, thin, often slightly translucent, glossy coal-like, grey or grey-black scales, becoming scattered, narrower and black further up; rachis bearing scattered, small, narrowly lanceolate, black scales, mixed with some hair-like, black or blackish brown ones. Lamina once pinnate, broad (up to *c.* 40 cm wide), mid-green above, bearing many (up to *c.* 30 pairs) wide, usually well-spaced, glabrous, herbaceous pinnae; pinnae ranging from merely toothed, with markedly straight sides, to well-lobed, the lobes varying from shallow, square ones to somewhat extended and ± rounded ones, though usually ± truncate at their apices, usually bearing a small tooth at the acroscopic corner of each lobe. Sori indusiate, though in occasional specimens the indusia may be very small or even absent from a number of sori; indusia thin, often rather small, scarious, lifting and shrivelling markedly, and sometimes partially deciduous in old herbarium specimens. Spores regular.

Fig. 3 *Dryopteris hirtipes* subsp. *atrata*. India, Tamil Nadu, Palni Hills, north of Kodaikanal, 19 December 1978, *C. R. Fraser-Jenkins* 9164 (BM). Scale line = 1 cm.

Cytology: Tetraploid sexual (S. India: Abraham, Ninan & Mathew (1962). Bhavanandan (1968). Bir & Vasudeva (1971), voucher specimen, *S. S. Bir*, 10 June 1962, etc. (PAN 4694!, 4695!, PUN!). Bhavanandan (1981). E. Himalaya: Loyal in Mehra (1961). Mehra & Bir (1964). Mehra & Loyal (1965), voucher specimen, *D. S. Loyal*, 23 July 1957 (PAN 2106, 2283, etc.!). Gibby (1985)).

Ecology: A species of lower mid-level forests, growing on the forest floor, from *c.* 1500–2000 m alt.

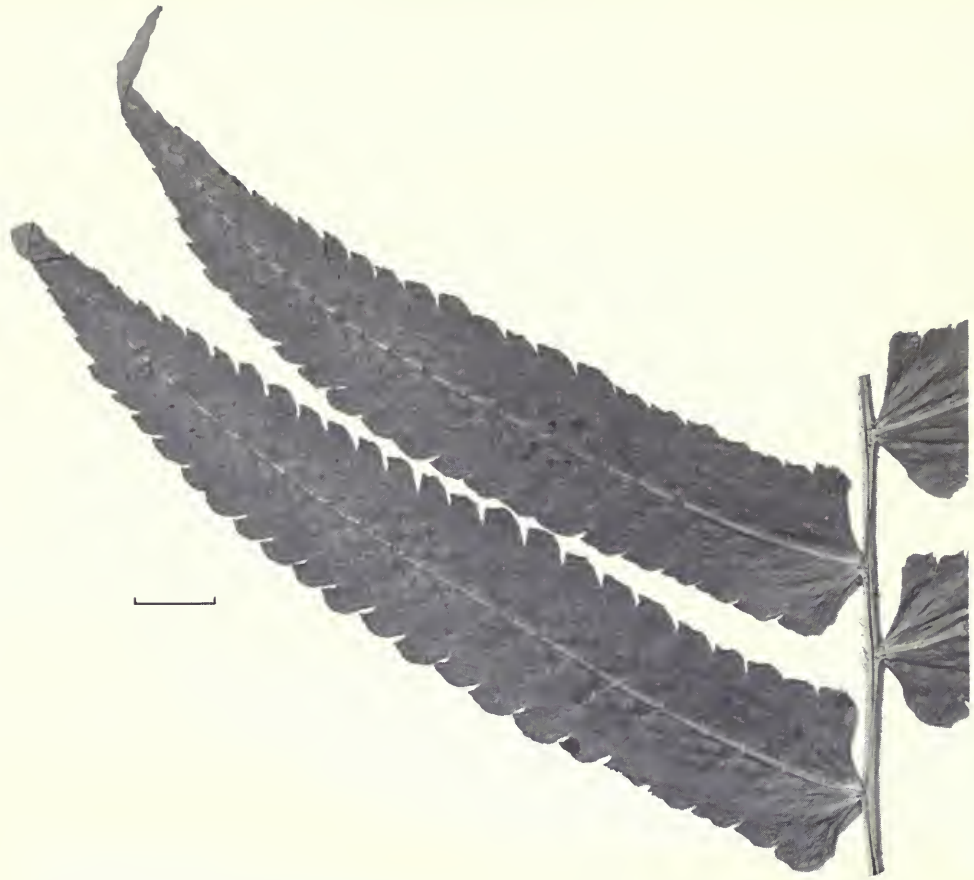

Fig. 4 *Dryopteris hirtipes* subsp. *atrata* (form with straight-sided pinnae). India, 'Khasya, *H*[*ooker*] *et T*[*homson*] 278' (BM). Scale line = 1 cm.

Range: Sri Lanka; India (E. Himalaya in Sikkim; Assam; S. India); central and east Nepal; Bhutan; SE. Tibet; China (Yunnan); Burma; Thailand; S. Vietnam. Probably to be considered a south-east Asian element.

Range in the Indian subcontinent: **58** Nepal, 1829, *Wallich* (BM!); **62** Dhankuta, Sanghu, 6000 ft (1830 m), 11 June 1962, *A. H. Norkett* 8756 (BM!); **64** Lebong, Darjeeling, 25 October 1980, *C. R. Fraser-Jenkins* 10383–10386 (BM!); **65** Sikkim, *J. D. Hooker & T. Thomson* 19 (BM!); **67** Rinchu (1300 m) to Mishichen (1400 m), 9 May 1967, *H. Kanai et al.* 14071 (TI!); **72** Pintsogong, 27° 15′N, 91° 34′E, 5000 ft (1520 m), *F. Ludlow, G. Sherriff & G. Taylor* 7206 (BM!, PE!); **83** Khasia, *J. D. Hooker & T. Thomson* 278 (BM!); **92** Kottayam District, Umaiya Malai (MH!); **93** Nilgiris, Naduvattam, *K. Subramanyam* 10586 (MH!); **94** Devicolam, 6000 ft (1830 m), December 1910, *A. Meebold* 13423 (B!); **95** Near Kodaikanal, Palni Hills, 19 December 1978, *C. R. Fraser-Jenkins* 9164, 9165 (BM!), 9164–9167, 9170–9174 (H!); **100** Ceylon, *Mrs Walker* 56 (K!). Also (locality not found): Madras, Attiken, Billigirangan Hills, 5200 ft (1580 m), December 1938, *E. Barnes* 495 (MICH!).

Notes: Earlier authors widely misapplied the epithet *atrata* to other species in the Himalaya. However, it is clear from Kunze's (1851) description of *Aspidium atratum* (very large plants, etc.) that his concept applies to the south Indian collections that he cited and not to Wallich's invalidly named Himalayan plant (now referred to *D. stenolepis*), as was thought by Christensen (1931), Ching (1938), and others. Sledge (1973) has clarified the status of the name *Dryopteris atrata*, reducing it to a synonym of *D. hirtipes*. He was unable to separate *D. hirtipes* from *D. scottii*, and did not separate subsp. *atrata* from subsp. *hirtipes*. In mentioning exindusiate plants

(indusia lacking even in young sori) from Sri Lanka, he did not take account of the other features separating *D. scottii* from *D. hirtipes*, and indeed his specimen (*W. A. Sledge* 1190 (BM!)) is not fully exindusiate but has a few small indusia, as sometimes occurs in *D. hirtipes*, while other specimens (K!) that he mentions are old and have presumably lost most of their indusia.

A report, sub *D. atrata*, of a taxon from Taiwan with n = 82 (Tsai, 1973; Tsai & Shieh, 1975) requires further investigation as to its identity, etc.

Dryopteris commixta Tag., from Japan, S. Korea (Cheju Do), and SE. China (Fukien, Kiangsi, Chekiang), is a similar species which differs in its slightly wider scales, wide, square pinna-lobes, and sori with vestigial indusia. It is also tetraploid sexual (Japan: Kurita, 1967; Hirabayashi, 1969, 1974).

3. **Dryopteris darjeelingensis** Fraser-Jenkins, **sp. nov.** **Fig. 5**

Planta *D. scottii* similis, sed paleis stipitis rhachidisque plus numerosis, pinnis valde angustioris, lobis pinnarum rectangularibus, indusiis minimis vestigialibus, differt. Cytotypus triploideus, apomictus. Type: N. India, W. Bengal, Manebhanjang to Sukia Pokhri, south-west of Darjeeling, forest, *c.* 2200 m, 16 November 1978, *C. R. Fraser-Jenkins* 8557 (BM! – holotype; H! – isotype). Other specimens from the type locality are located as follows: 8558–8561 (BM!), 8558, 8560–8564, 8567, 8569 (H!).

Fronds medium-sized (up to *c.* 100 cm long). Stipe up to *c.* ½ as long as the lamina, stipe-base bearing numerous, narrowly lanceolate or lanceolate, thickish, black scales, which become somewhat less dense and very narrow further up and on the rachis. Lamina once pinnate, of medium width (up to *c.* 30 cm wide), bearing many (up to *c.* 25 pairs) slightly crowded, narrow pinnae; pinnae herbaceous, ± matt in texture and ± pale- to mid-green above, slightly wider at their bases and tapering to their apices, bearing somewhat shallow, narrow, rectangular lobes which become ± deep (up to *c.* ½ the depth of the pinna on either side of the midrib) at the bases of the lowest pairs of pinnae, each lobe bearing one or more small, acute teeth, especially at its acroscopic corner. Sori indusiate; indusia ± minute, very thin, vestigial and not covering the whole sorus, shrivelling later, absent from occasional sori. Spores irregular, with fully formed and a minority of abortive spores.

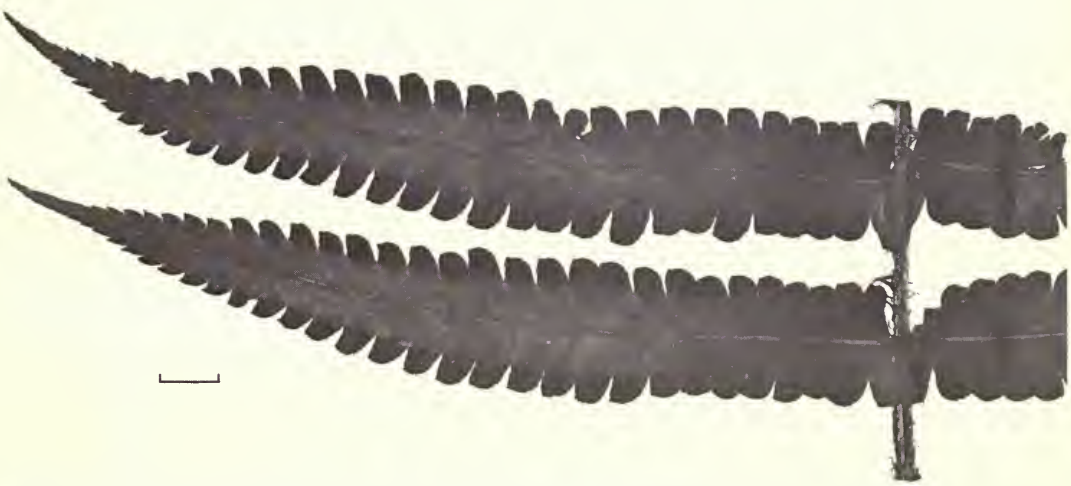

Fig. 5 *Dryopteris darjeelingensis*. India, West Bengal, Darjeeling, Manebhanjang to Sukia Pokhri, 16 November 1978, *C. R. Fraser-Jenkins* 8561 (BM). Scale line = 1 cm.

Cytology: Triploid apomict (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), sub *D. atrata*, voucher specimen, *D. S. Loyal* 3, July 1958 (PAN 2512, etc.!). Gibby (1985)).

Ecology: A species of mid-level forests, growing on the forest floor, often between bushes, from *c.* 1800–2200 m alt.

Range: India (E. Himalaya in Sikkim). Apparently an endemic Sino-Himalayan species of the east Himalayan sort.

Range in the Indian subcontinent: **64** As above, type of *D. darjeelingensis*; **65** Singhik, 5500 ft (1680 m), July 1958, *D. S. Loyal* 3 (PAN 2512!).

Notes: This species is intermediate in morphology between *Dryopteris scottii* and *D. stenolepis* and may be distinguished from the former by its narrower pinnae and the presence of small indusia, visible with a lens. Mehra & Loyal's (1965) plant has somewhat less lobed pinnae and larger indusia than the type, but is similar in other respects. They reported equal numbers of bivalents and univalents at meiosis in the 16-celled sporangia. It is thus different cytologically (and morphologically) from another triploid apomictic species, *D. cycadina* (Franchet & P. A. L. Savat.) C. Chr., from Japan and SE. China, which was investigated by Manton (1950) sub *D. atrata* (of cultivated origin) and showed failure of pairing.

4. Dryopteris stenolepis (Baker) C. Chr. **Fig. 6**

Index filic.: 294 (1905). – *Polypodium stenolepis* Baker in *Bull. misc. Inf. R. bot. Gdns, Kew* 1898: 231 (1898). – *Dryopteris hirtipes* var. *stenolepis* (Baker) C. Chr. in *Contr. U.S. natn. Herb.* **26**: 279 (1931). – *Dryopteris atrata* var. *stenolepis* (Baker) Tag. in *Acta phytotax. geobot. Kyoto* **10** (4): 281 (1941). Type: China, Yunnan, Mengtze, forest, 5000–6000 ft, *A. Henry* 9038 (K! – lectotype, selected here; E! – isolectotype).

Aspidium atratum Wallich, *Num. List*: no. 380 (1828), nom. nud. (Art. 32.1) [non Kunze in *Linnaea* **24**: 279 (1851)]. – *Lastrea atrata* C. Presl, *Tent. pterid.*: 77 (1836), nom. nud. (Art. 32.1). Specimens: from Nepal (BM!, K!, K-W!).

Aspidium aduncum Wallich, *Num. List*: no. 384 (1828), nom. nud. (Art. 32.1). Specimens: from Nepal (BM!, K!, K-W!).

Nephrodium gamblei C. Hope in *J. Bombay nat. Hist. Soc.* **12** (3): 533, pl. 7 (1899). – *Dryopteris gamblei* (C. Hope) C. Chr., *Index filic.*: 267 (1905). Type: India, Darjeeling, 7000 ft (2130 m), September 1879, *J. S. Gamble* 7075 (P! – lectotype; selected here).

Misapplied name: Dryopteris atrata auct. Indian., p.p.

Fronds medium-sized or large (up to *c.* 125 cm long). Stipe *c.* ½ the length of the lamina, stipe-base bearing a prominent tuft of long, lanceolate, ± pale brown scales at the very base, which become black at the widest part of the stipe-base, occasional specimens with only black scales; stipe and rachis markedly densely scaly with long, narrow, black scales, which become very narrow or hair-like on the rachis; specimens from dry, exposed places may be less densely scaly. Lamina once pinnate, wide (up to *c.* 30 cm), matt, dull pale- to mid-green above, and usually more coriaceous and thicker than in *Dryopteris scottii*, *D. hirtipes*, and *D. darjeelingensis*, bearing many (up to *c.* 40 pairs) crowded pinnae; pinnae markedly long and narrow, slightly

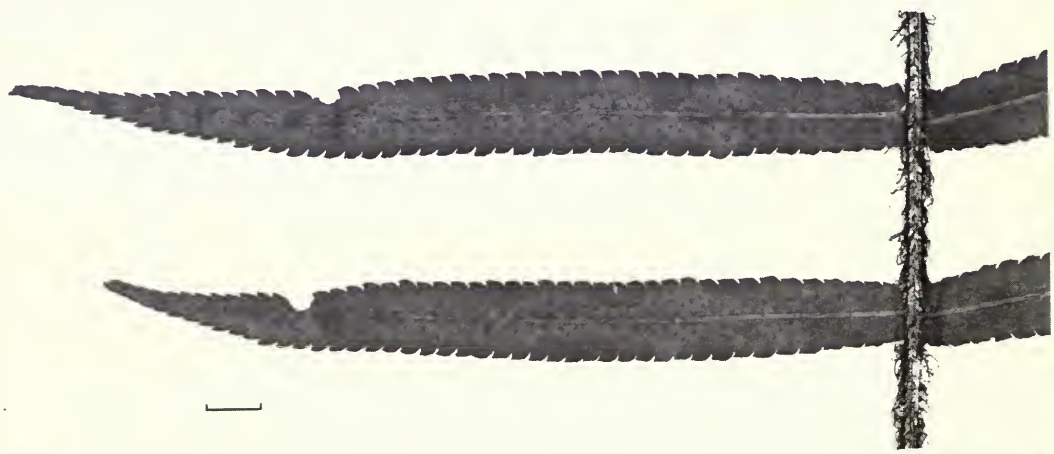

Fig. 6 *Dryopteris stenolepis*. India, Meghalaya, Khasi Hills, above Shillong, 24 November 1978, *C. R. Fraser-Jenkins* 8825 (H). Scale line = 1 cm.

crowded, ranging from merely toothed to ± shallowly lobed with rectangular lobes, each bearing one or more teeth at the distal side, the upper pinnae markedly unlobed and ± smooth-sided. Sori indusiate; indusia ± prominent, somewhat thick, shrivelling somewhat but mostly persistent, even in old specimens. Spores regular.

Cytology: Diploid apomict (E. Himalaya and SW. China: Gibby (1985)).

Ecology: A species of mid-level bushy slopes and light forest, growing on the ground, from *c.* 1000–2200 m alt.

Range: India (eastern part of the W. Himalaya; E. Himalaya in Sikkim; Assam); Nepal; Bhutan; SE. Tibet; N. Burma; S. China (Yunnan, Szechuan, Kwangsi, Hupeh, Kweichow); Taiwan; N. Vietnam; Laos. A Sino-Himalayan species of the widespread sort.

Range in the Indian subcontinent: **42** [Probably Tehri Garhwal], April 1881, *P. W. & V. A. Mackinnon* (BM!, P!) and Tehri Garhwal, May 1880, *W. Gillan* (CAL!, DD!); **50** Doti District, Bhabma village, 20 May 1929, *Bis Ram* 432 (DD!, PE!); **58** Phulchoki, 5000 ft (1520 m), 15 May 1969, *P. R. Sakya* 16 (KATH!); **59** Ghoda Tabela to Thulosyapru, Langtang, 2120 m, 7 October 1977, *V. L. Gurung & party* 77/734 (KATH!); **60** Near Namche, 8000 ft (2440 m), 9 May 1965, *M. L. Banerji, A. V. Upadhya & B. B. Basukola* 3426 (KATH!); **64** Banstead, Darjeeling, July 1879, *J. S. Gamble* 6968 (K!); **65** Sikkim, 1857, *T. Thomson* (BM!, K!); **67** Mishina (1300 m) to Dochu La (3050 m) to Thimpu (2250 m), 28 April 1969, *H. Kanai et al.* 10316 (BM!, TI!); **68** Rukubi (2600 m) to Chendebi (2300 m) to Charikhachor (2250 m) to Neylong (2200 m), 14 April 1967, *H. Kanai* et al. 4109 (TI!); **74** Bomdila, Rahung, 8600 ft (2620 m), 13 May 1957, *R. S. Rao* 7346 (DD!); **75** Subansiri, with *Dryopteris scottii* (CAL!); **78** Rahoto, Vokanoska, Tirap Frontier Division, 26 August 1958, *G. Panigrahi* 16828 (K!); **79** Takubama, Naga Hills, 7000 ft (2130 m), 18 August 1950, *W. N. Koelz* 25819 (MICH!); **80** Sungtun, 7000 ft (2130 m), 6 December 1950, *W. N. Koelz* 27100 (MICH!); **83** Shillong, 6100 ft (1860 m), 6 September 1886, *C. B. Clarke* 44635 (CAL!, K!), and stream gulley in *Pinus* forest, below Peak Lodge, 10 km above Shillong on road to the Peak, Khasi Hills, 1800 m, 24 November 1978, *C. R. Fraser-Jenkins* 8820, 8821 (BM!), 8821–8825 (H!).

Notes: Reported here for the first time from the Indian subcontinent under the name *Dryopteris stenolepis*, though Hope's (1899) account of *D. gamblei* was the first recognition of the species from the area. Panigrahi (Panigrahi & Basu, 1982) has published the determinations made by the present author in Calcutta and other Indian herbaria when he was still using the name *D. gamblei* for this species, and has thus used the name in error. He also selected as the lectotype a specimen of Gamble's (no. 254) in Calcutta, despite the fact that Hope (1899) made more direct mention of the specimen selected above and even stated that he had no time to note particulars of the specimens of *Nephrodium gamblei* in Calcutta. It is clear that the Calcutta specimen cannot be selected as a representative part of the original material on which Hope worked, and Panigrahi's lectotype is therefore replaced.

Hope (1899) and Ching (1938) were the only authors to distinguish this species from other members of the group and were correct in doing so. *Dryopteris stenolepis* is a large plant with distinctly denser and narrower scales on the stipe and rachis than *D. hirtipes*, and longer, narrow pinnae. The two species are almost certainly related. Another somewhat similar species is *D. cycadina* (Franchet & P. A. L. Savat.) C. Chr., from Japan, Taiwan, and SE. China (Kwangtung, Kwangsi, Kweichow, Chekiang, Kiangsi, Hunan, Kiangsu, Fukien), which differs in its smaller size and narrower fronds with narrower pinna-lobes and more deflexed lowest few pinnae. It is a triploid apomict, apparently related to *D. hangchowensis* Ching, from Japan, Taiwan, and China (Chekiang, Kiangsi), which is diploid sexual (Hirabayashi, 1974) with denser, black stipe-scales and more deeply lobed pinnae, the lobes becoming almost separate at the base of the lowest pinnae.

5. Dryopteris dickinsii (Franchet & P. A. L. Savat.) C. Chr. **Fig. 7**

Index filic.: 262 (1905). – *Aspidium dickinsii* Franchet & P. A. L. Savat., *Enum. pl. Jap.* **2**: 236 (1877), 629 (1879). – *Nephrodium dickinsii* (Franchet & P. A. L. Savat.) Baker in Hook., *Icon. pl.* **17**: pl. 1659 (1886). Type: Japan, 'circa Atami in jugo Hakone', *Dickins*, Herb. Savatier (P! – lectotype, selected here; K!, PE! – isolectotypes).

Aspidium thibeticum Franchet in *Nouv. Archs Mus. Hist. nat. Paris* II, **10**: 118 (1887). – *Nephrodium*

thibeticum (Franchet) Baker in *Ann. Bot.* **5**: 318 (1891). – *Lastrea thibetica* (Franchet) Beddome, *Suppl. ferns Brit. Ind.*: 52 (1892). – *Dryopteris thibetica* (Franchet) C. Chr., *Index filic.*: 298 (1905). Type: China, Prov. de Moupin [Pao-Hsin; Po-Shin, Szechuan], 1870, *M. L'Abbé David* (P! – lectotype, selected here; BM!, PE! – isolectotypes).

Dryopteris okushirensis Miyabe & Kudô in *Trans. Sapporo nat. Hist. Soc.* **7**: 23 (1918). Type: Japan, Hokkaido, Shiribeshi Province, Okushiri Island, between Tsurikake and Poronai, 4 August 1916, *Y. Kudô* 2178 (SAP – holotype).

Dryopteris hirtipes var. *japonica* Nakai in *Bot. Mag., Tokyo* **45**: 100 (1931). Type: Japan, 'Okugawa tractus Maya, prov. Iwashiro', 14 August 1914, *S. Tamaki* (TI! – holotype).

Dryopteris basiaurita Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8** (6): 405 (1938). Type: India, Kashmir, Lolab valley, 6000 ft, 15 June 1903, *R. C. Wroughton* (US 595312! – lectotype, selected here; PE!, US! – isolectotypes).

Dryopteris yungtzeensis Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **11**: 60 (1941). Type: China, Yunnan, Atuntze [Deching], 3000 m, 8 August 1940, *K. M. Feng* 6429A (PE! – holotype).

Misapplied name: Dryopteris pycnopteroides auct. Japan.

Fronds medium-sized or somewhat small (up to *c.* 80 cm long). Stipe *c.* ¼ the length of the lamina, stipe-base bearing short, widely lanceolate, glossy scales, varying from very pale brown to mid-brown, or rarely dark brown to black, which become scattered and smaller further up and on the rachis, but remain rather short and wider than in other species; usually some, at least, are pale on the mid- or upper stipe, though plants with all dark scales exist. Lamina once pinnate, narrow (up to *c.* 20 cm wide), bearing rather few (up to *c.* 25 pairs) somewhat short pinnae of medium width and spacing; pinnae herbaceous, almost slightly succulent, ± pale green above, markedly glabrous and smooth-textured, with noticeably darker coloured and often somewhat impressed veins especially on the underside in the lower sterile pinnae, the pinna-bases frequently slightly widened into auricles on one or both sides (abnormally markedly auriculate), the rest of the pinna varying from almost unlobed to bearing deep, rectangular, or somewhat extended, rounded lobes with narrowed, ± truncate apices, with one or more small teeth mainly on the distal side. Sori distinct from the other species of this section in the area, in being positioned in a more or less narrow belt away from the pinna-costa on either side, not far from the edge, or becoming arranged in loops around the lobes, when they may reach the pinna-costa, indusiate; indusia small, very thin, scarious, shrivelling markedly at maturity, many, but not all, dropping off. Spores irregular, with fully formed and a minority of abortive spores.

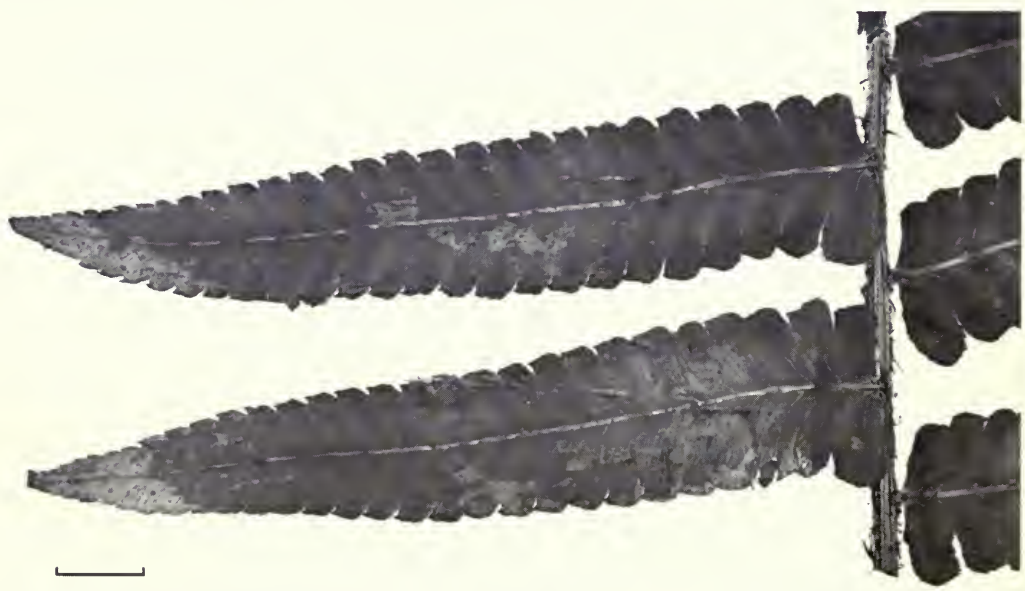

Fig. 7 *Dryopteris dickinsii.* Japan, prov. Tamba, Yugemura, 27 July 1933, *Tagawa-Motozi* 673 (BM). Scale line = 1 cm.

Cytology: Diploid apomict (W. Himalaya: Gibby (1985). Japan: Kurita (1965). Hirabayashi (1974), etc.).

Ecology: A species of lower mid-level forests, growing on the ground, from *c.* 1700–2700 m alt.

Range: India (W. Himalaya, uncommon); SE. and E. Tibet; S. and central China (Yunnan, Szechuan, Kweichow, Hupeh, Kiangsi, Kwangsi, Chekiang, Anwhei, Hunan, Shensi, Kansu, Fukien); Taiwan; Japan. A Sino-Himalayan species distributed as a west Himalayan species in the Indian subcontinent.

Range in the Indian subcontinent: **24** Ghantamula [nr Baramulla], Tangdur Forest, 5300 ft (1620 m), August 1891, *J. C. McDonell* (K!, P!); **25** Lolab valley, 6000 ft (1830 m), 15 June 1903, *R. C. Wroughton* (US 595312, etc.!); **37** Raiengarh [Ravingarh, nr Chhachpur] forest, 6500 ft (1980 m), May 1898, *J. S. Gamble* 26778 (BM!, K!), and Chhachpur valley, 6000 ft (1830 m), 25 May 1898, *J. F. Duthie* 21059 (B!, BM!, DD!, E!, K!); **42** Tiri Garhwal, 9000 ft (2740 m), April 1881, *P. W. & V. A. Mackinnon* (P!).

Notes: Dryopteris dickinsii is reported here from the Indian subcontinent for the first time, though some of the above specimens were cited by Hope (1903) under *Nephrodium hirtipes*. Ching (1938) was the first person to notice that the west Himalayan plant was distinct from *D. hirtipes* etc. and redescribed it as *D. basiaurita*, so named from his somewhat abnormal, slightly auriculate specimens. The specimens from the Chhachpur area (area 37) have somewhat dark scales which also occur quite frequently in *D. dickinsii* in Japan and China, though a distinct species with considerably denser, dark scales has been described from Japan as *D. namegatae* Kurata and also occurs in S. China (Yunnan, Szechuan, Kweichow, Hunan, and Kiangsi). The dividing line between *D. namegatae*, which has been tentatively reported from Japan as triploid, and dark-scaled plants of *D. dickinsii* is difficult to define and probably requires investigation; there is a slight possibility that the Chhachpur plants could even represent *D. namegatae*. *Dryopteris thibetica* (Franchet) C. Chr. from Szechuan, China merely represents more deeply lobed specimens of *D. dickinsii* with the sori extending around the lobes and below them, at the sinus, reaching the costa, a form which occurs throughout its range. In cultivation in more dry or open conditions such plants return to normal.

Two species similar to *D. dickinsii* are *D. handeliana* C. Chr. from China (Szechuan, Kweichow, Hupeh, Hunan, Chekiang, and Anwhei) and Japan, which differs in its smaller size, unlobed, short, elliptic-acute pinnae and narrow belt of markedly marginal sori, and is diploid sexual, and *D. pycnopteroides* (Christ) C. Chr. from west China (Yunnan, Szechuan, Kweichow, Kansu) and Taiwan, with sori near the costa and not submarginal, and usually only brown or pale scales. *D. pycnopteroides* appears to be close to *D. dickinsii* and requires cytological and other investigation, since the Japanese cytological reports are not relevant to true *D. pycnopteroides*. There is another related species, *D. subpycnopteroides* Ching ex Fraser-Jenkins in south-west China, while yet another, *D. hangchowensis* Ching, which is reported as diploid, occurs in south-east China, Taiwan, and Japan.

6. Dryopteris lunanensis (Christ) C. Chr. **Fig. 8**

Index filic.: 276 (1905). – *Aspidium lunanense* Christ in *Bull. Herb. Boissier* **6**: 966 (1898). Type: China, Yunnan, Lunan, *A. Henry* 10584 (P! – holotype; K!, P! – isotypes).

Dryopteris semipinnata Ching, *Fl. Tsinlingensis* **2**: 226 (1974). Type: China, Kansu, Wen Hsien, 1 October 1964, *Y. P. Hsu* 1822 (SIAN – holotype; PE! – isotype, photograph and pinna).

Fronds large (up to *c.* 90 cm long). Stipe long, ± the same length as the lamina, stiff and thin, stipe-base bearing somewhat dense, long, narrowly lanceolate, black scales, sometimes with brown ones at the very base, the rest of the stipe and the rachis bearing somewhat scattered, very narrow, but not hair-like, black scales, which are mostly adpressed and do not stand out noticeably. Lamina once pinnate, becoming a second time pinnatifid (or nearly twice pinnate) at the base of the lowest pinnae, ± broad (up to *c.* 20 cm wide), the base markedly widely truncate and not narrowed, bearing many (up to *c.* 25 pairs) long, narrow, ± well-spaced pinnae; pinnae stiff-coriaceous, almost crispaceous, drying a somewhat grey-green above, narrower at their bases than in their middle regions, bearing many conspicuous, ± narrow lobes extending up to

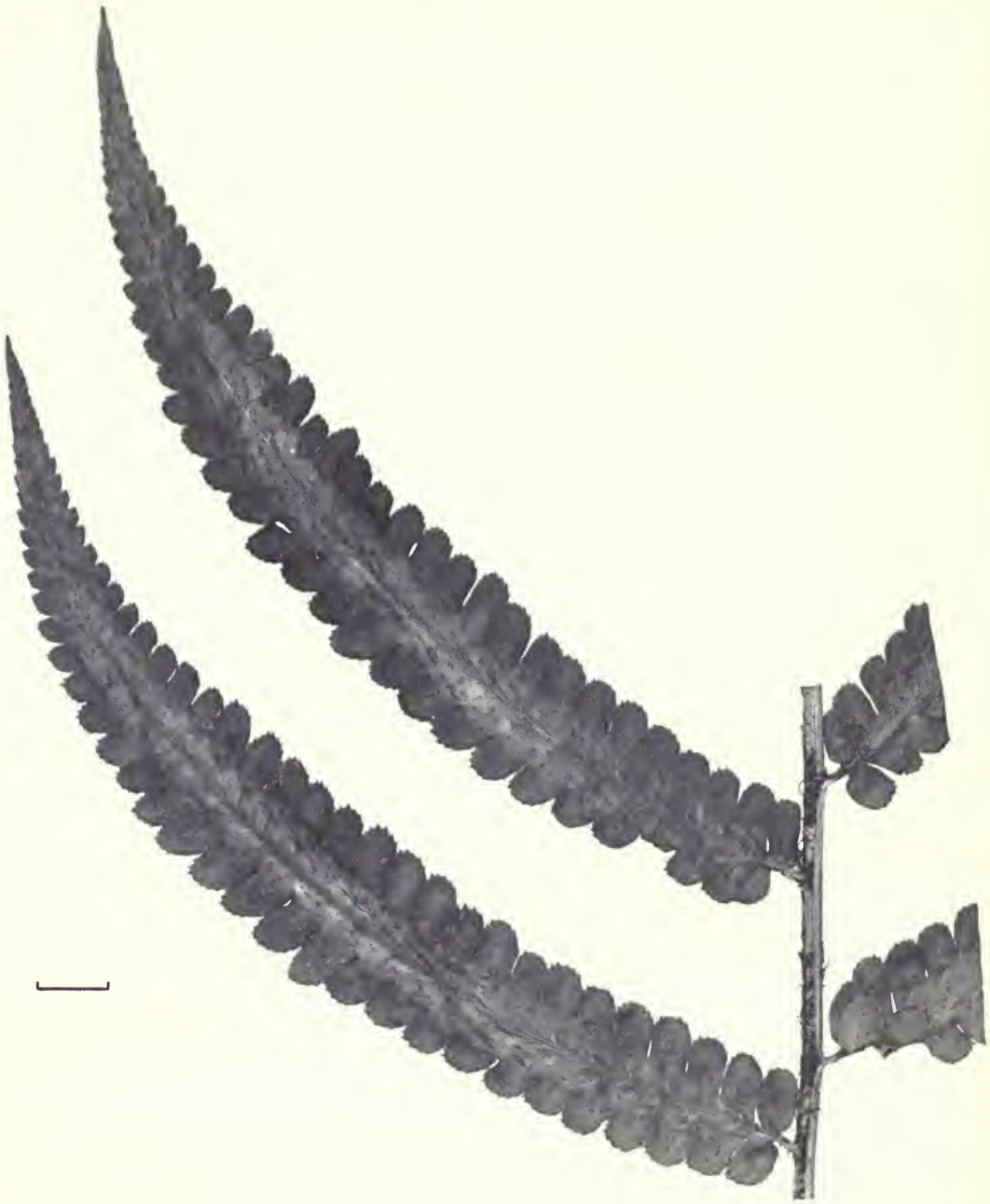

Fig. 8 *Dryopteris lunanensis*. Bhutan, Tinlegang to Gon Chungnan, 5 May 1967, *H. Kanai et al.* 14832 (BM). Scale line = 1 cm.

half the depth of the pinna on each side, but almost dissect to the costa at the base of the basal pairs of pinnae; pinna-lobes ± parallel-sided, but with rounded apices, bearing several short, acute, stiff, hair-pointed teeth around the apices, which are sharp to the touch. Sori arranged submarginally around the lobes in loops, nearly reaching the pinna-costa, indusiate; indusia somewhat thick, shrivelling and lifting at maturity, many of them subsequently dropping off. Spores irregular, with fully formed and a minority of abortive spores.

Cytology: Unknown. The irregular spores suggest that it is an apomict.

Ecology: A species of mid-level forests, growing on the ground, from *c.* 1500–1800 m alt.

Range: Bhutan (rare); SE. Tibet; China (Yunnan, Szechuan, Kweichow, Kansu, Hunan). A Sino-Himalayan species of the east Himalayan sort.

Range in the Indian subcontinent: **68** Tinlegang (1750 m) to Gon Chungnang (1600 m) [above Punakha], 5 May 1967, *H. Kanai, G. Murata, H. Ohashi, O. Tanaka & T. Yamazaki* 14832, Third Japanese Bot. Exped. to the E. Himalaya (BM!, TI!).

Notes: This little-known species is reported for the first time from the Indian subcontinent, where it is known only from a single collection, though others may be expected if botanical collecting is ever allowed in the far east Himalaya. *Dryopteris lunanensis* and *D. conjugata* are both somewhat intermediate between the sections *Hirtipedes* and *Fibrillosae*, and are more deeply lobed than the other species dealt with so far, but whereas *D. conjugata* appears to be related to *D. wallichiana*, *D. lunanensis* shows more similarity to *D. lepidopoda*.

7. Dryopteris conjugata Ching **Fig. 9**

in *Bull. Fan meml Inst. Biol.* (Bot.) **11**: 63 (1941). Type: China, Yunnan, Changmutong, Kong Shan Hsien [near upper Burmese border], 1800–2100 m, 14 September 1940, *K. M. Feng* 7343 (PE! – holotype).

Fronds large (up to *c.* 130 cm long). Stipe long, up to *c.* ½ the length of the lamina, ± thick, stipe-base bearing numerous long, lanceolate, mid- to pale brown scales, stipe and rachis densely furnished with markedly long, projecting, very narrow, mid-brown scales. Lamina once pinnate, becoming bipinnatifid at the base, somewhat wide (up to *c.* 30 cm wide), widely truncate and only slightly narrowing at the base, bearing many (up to *c.* 50 pairs) crowded

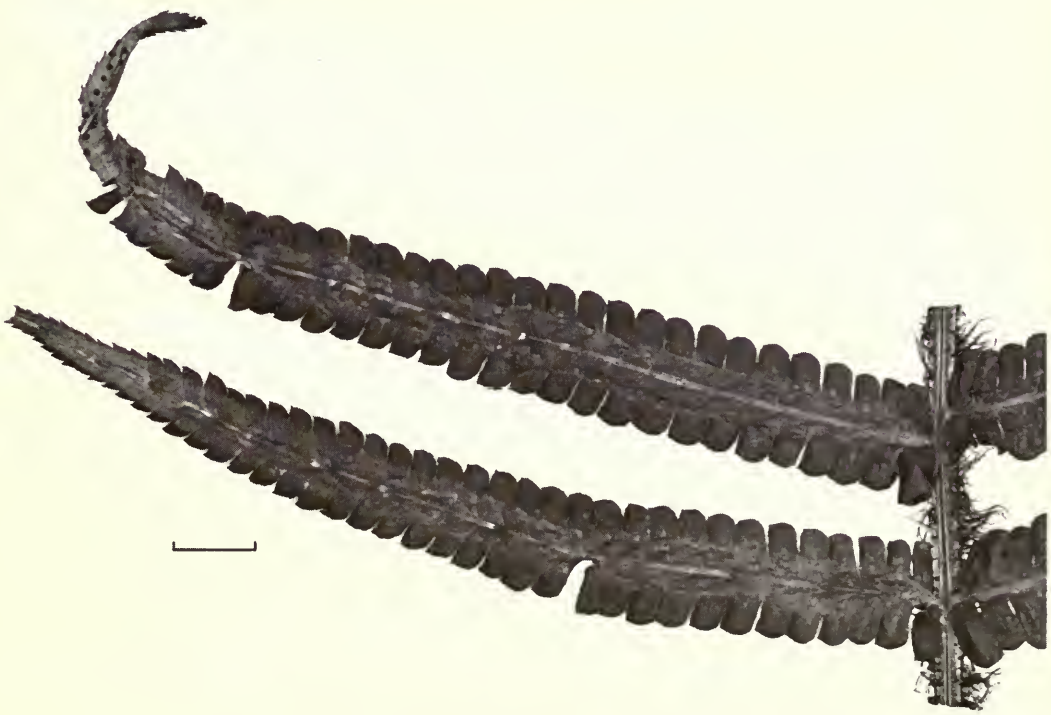

Fig. 9 *Dryopteris conjugata*. India, Himalaya, [probably above Simla], *Col. Bates* (BM). Scale line = 1 cm.

pinnae; pinnae slightly coriaceous and glossy above, bearing many conspicuous lobes extending up to half the depth of the pinna on each side; pinna-lobes parallel-sided with truncate apices, occasionally bearing a few insignificant, broad-based, acute teeth. Sori in two vertical rows one on each side of the centre of each lobe, nearly reaching the pinna-costa, indusiate; indusia ± thick, shrivelling slightly and lifting at maturity, often partially deciduous. Spores irregular. with fully formed and a minority of abortive spores.

Cytology: Unknown.

Ecology: A species of mid- to upper-level forests, growing on the ground, from *c.* 1800–2000 m alt.

Range: India (eastern parts of the W. Himalaya, rare); Nepal (rare); Burma; SW. China (Yunnan). Apparently not yet collected from the E. Himalaya. A rare Sino-Himalayan species of the widespread sort.

Range in the Indian subcontinent: **37** Above Simla, *Bates* (BM!, K!); **42** Garhwal, *P. W. & V. A. Mackinnon* (K!); **48** Kumaon, *R. Strachey & J. E. Winterbottom* 3, 4 (BR!, K!), and Pithoragarh, 1987, *N. Punetha* (Herb. C. R. Fraser-Jenkins!); **58** 'Napalia', *Wallich* 380, with *Dryopteris stenolepis* (E!, K!).

Notes: This species is reported from the Indian subcontinent for the first time here, though Clarke and Hope recognised it in the herbarium as var. *simlensis*, a name which was never published. Its markedly distinct morphology is intermediate between that of *D. wallichiana* and *D. stenolepis*, and it appears similar to a less deeply lobed *D. wallichiana* with dense, fine, grey-brown scales. The SW. Chinese species, *D. subpycnopteroides* Ching ex Fraser-Jenkins is intermediate in morphology between *D. conjugata* and *D. pycnopteroides* (Christ) C. Chr.

Section 2. Fibrillosae Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 366 (1938).

8. Dryopteris pulcherrima Ching **Fig. 10**

in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 422 (1938). Type: China, Honan, Lushih-Hsien, Laochün Shan, 1420 m, ombragés, humides, des bois de pumbus, 1 September 1935, *Ki-Mon Liou* 5344 (PE! – holotype).

Nephrodium filix-mas var. *fibrillosa* C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 520, pl. 70 (1880). – *Lastrea filix-mas* var. *parallelogramma* subvar. *fibrillosa* (C. B. Clarke) Beddome, *Handb. ferns Brit. India*: 249–250 (1883). – *Dryopteris filix-mas* subsp. *patentissima* var. *fibrillosa* (C. B. Clarke) C. Chr., *Index filic.*: 265 (1905). – *Dryopteris fibrillosa* (C. B. Clarke) Hand.-Mazz. in *Anz. Akad. Wiss. Wien* **7**: 2 (1922), nom. illeg. (Art. 64.1), non (Baker) C. Chr. (1905). – *Dryopteris filix-mas* subsp. *fibrillosa* (C. B. Clarke) C. Chr. in *Acta Horti gothoburg.* **1**: 57 (1924). – *Nephrodium clarkei* var. *fibrillosa* (C. B. Clarke) Hand.-Mazz., *Symb. sin.* **6**: 24 (1929). Type: India, Sonamarg [Kashmir], 11,000 ft, 29 August 1876, *C. B. Clarke* 30819A (K! – lectotype, selected here).

Dryopteris sinofibrillosa Ching in *Bull. Fan meml Inst. Biol* (Bot.) **10**: 180 (1940). Type: as for *Nephrodium filix-mas* var. *fibrillosa*.

Dryopteris chingii Nair in *Indian Forester* **94**: 169 (1968), nom. illeg. (Art. 63.1). Type: as for *Nephrodium filix-mas* var. *fibrillosa*.

Dryopteris squamifera Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 250 (1983). Type: Tibet, Chilung, 3400–3600 m, August 1975, *Chinghai-Xizang Expedition* 75–0617 (PE! – holotype; PE; – isotype).

Dryopteris discreta Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 251 (1983). Type: Tibet, Chilung, 3200 m, 15 July 1975, *Chinghai-Xizang Expedition* 6364 (PE! – holotype).

Dryopteris canaliculata Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 251 (1983). Type: Tibet, Pome, Chin Do, 2900 m, 21 October 1960, *Fu, K. Sh.* 721 (PE! – holotype).

Dryopteris qandoensis Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 252 (1983). Type: Tibet, Zha Yu, Cha-Malang (Tsawarong), 3000 m, 5 June 1960, *Wu, S. K.* 8912 (PE! – holotype).

Dryopteris fibrillosissima Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 254, pl. 6, 11 (1983). Type: Tibet, Pome, Ku Xia (29° 55′N, 95° 30′E), 2880 m, 10 June 1965, *Ying, Jung-Sen* 65-0202 (PE! – holotype; PE! – isotypes).

Dryopteris zayuensis Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 255 (1983). Type: Tibet, Chayu, 3700 m, 26 June 1973, *Chinghai-Xizang Expedition* 73-373 (PE! – holotype).

Dryopteris nyalamensis ['*nyalamense*'] Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 256 (1983). Type: Tibet, Nyalamo Hsien, Chi Shiang, 3700 m, 30 June 1975, *Chinghai-Xizang Expedition* 6150 (PE! – holotype; PE! – isotype).

Dryopteris nyalamensis var. *angustipinna* Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 256 (1983). Type: Tibet, Me Dog, Na Kur, 2800 m, 3 August 1974, *Chinghai-Xizang Expedition* 74-4004 (PE! – holotype; PE! – isotype).

Misapplied name: Dryopteris rosthornii sensu Stewart (1945, 1951).

Fronds somewhat small (normally up to *c.* 70 cm long), forming perfect shuttlecocks. Stipe usually short, up to *c.* ⅕ the length of the lamina, stipe-base bearing a tuft of long, straight, narrowly lanceolate, mid-brown scales at the very base, with a dense mass of ovate-lanceolate or lanceolate, often twisted, glossy-black, or dark brownish-black, castaneous scales shortly above; remaining long and dark, but becoming slightly less dense, ± narrowly lanceolate and often markedly twisted on the rest of the stipe, where they are intermixed with numerous very small and narrow, hair-like, dark scales; rachis densely clothed with somewhat short, narrowly lanceolate, dark, or occasionally paler, scales, intermixed with very numerous short, hair-like, black, brown, or rarely pale, fibrillae. Lamina once pinnate, a second time pinnatifid, nearly become twice pinnate at the bases of the lower-middle pinnae, narrow (up to *c.* 15 cm wide) and gradually tapering towards a markedly narrow, but slightly truncate base, bearing many (up to *c.* 35 pairs) ± contiguous, short, narrow, regular pinnae; pinnae linear, herbaceous or slightly coriaceous, the upper surface dark green and slightly glossy, but bearing rather numerous small, scattered, narrowly hair-like, pale brown scales or fibrillae on the costae, costules, surfaces and edges, though these are semi-deciduous as the frond ages, and virtually glabrous plants may rarely occur, pinnae bearing numerous (up to *c.* 20 pairs) highly regular, small, mostly rectangular lobes, which do not become developed on the basiscopic sides of the lower pinnae;

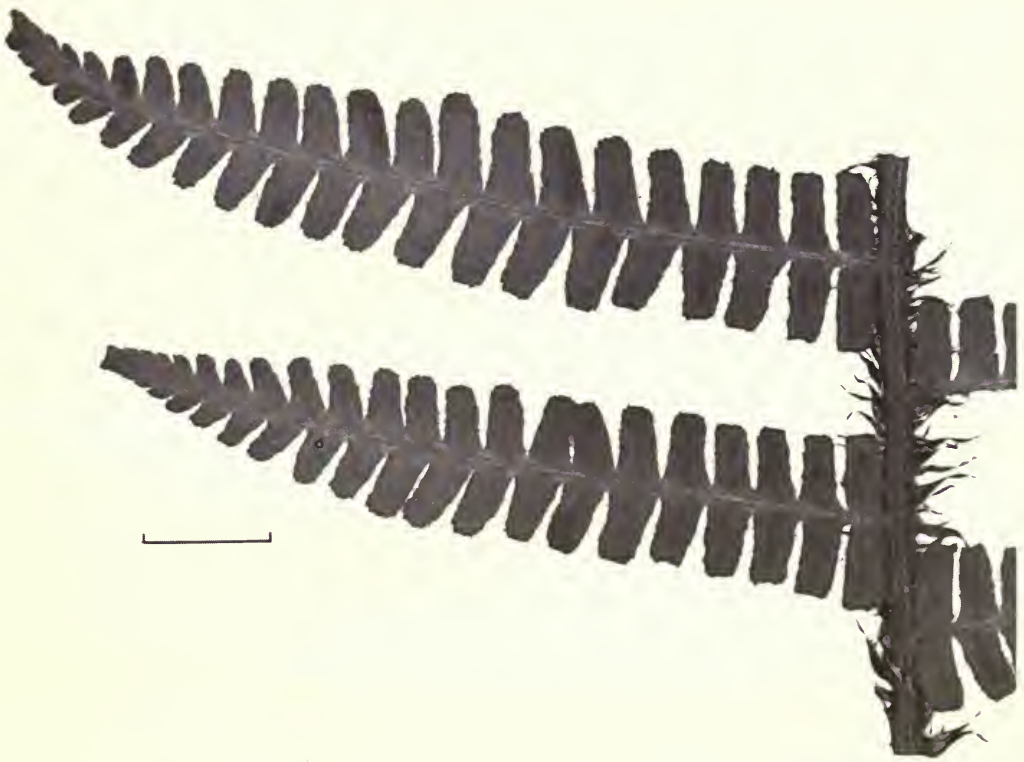

Fig. 10 *Dryopteris pulcherrima.* India, Himachal Pradesh, Simla, Narkanda, Mt Hattu, 26 August 1978, *C. R. Fraser-Jenkins* 7547 (BM). Scale line = 1 cm.

pinna-lobes joined only at their bases, markedly parallel-sided, though occasionally bearing small lobes at the sides, towards their apices, in the mid and upper parts of the frond, pinna-lobe apices ranging from markedly truncate to rounded-truncate or occasionally somewhat rounded-pointed (mainly in the upper half of the frond), bearing numerous small, acute crenations or teeth arranged about the apex (at least in the upper half of the frond). Sori in two rows, one on either side of the centre of the pinna-lobe, indusiate; indusia thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores irregular, with fully formed and a minority of abortive spores.

Cytology: Diploid apomict (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), sub *D. fibrillosa*, voucher specimen, *D. S. Loyal*, August 1956 (PAN 1426!, 1430!); another specimen, *D. S. Loyal*, July 1958 (PAN 2515!), has been labelled as diploid sexual, presumably in error for diploid apomict as its spores are the same size as in other specimens. W. Himalaya: Khullar in Löve (1970), voucher specimen, *S. P. Khullar* (PAN 5439!, 5440!). Mehra & Khullar (1980), voucher specimen, *S. P. Khullar* 83, July 1966 (PAN 5440!). Gibby (1985)).

Ecology: A species of the upper-level forest and scrub zones, growing on the ground, from *c.* 2000–4000 m alt.

Range: Pakistan (Himalaya west and east of the Indus); India (W. Himalaya; E. Himalaya in Sikkim); Nepal; Bhutan; S. and SE. Tibet; W. China (Yunnan, Szechuan, Kweichow, Honan, Hupeh, Kansu, Shensi, Shansi). Apparently not collected from N. Burma. A Sino-Himalayan species of the widespread sort. Reported from Taiwan by Li et al. (1975) in error for *Dryopteris redactopinnata* and by the same authors from Korea and Japan (probably based on the erroneous report of Ching (1938)) in error for *D. crassirhizoma* or *D. polylepis*.

Range in the Indian subcontinent: **14** Mountain west of Kalam, Swat, 3100 m, 2 October 1978, *C. R. Fraser-Jenkins* 7995 (BM!); **21** Sharda, Kishenganga valley, 4 October 1940, *F. Ludlow & G. Sherriff* 8251 (BM!); **24** Gulmarg, 2700 m, July 1966, *S. P. Khullar* 83 (PAN 5439!); **25** Andrbug in Lolab valley, September/October 1891, *R. W. Macleod* (P!); **26** Near Pahlgam, 7–8000 ft (2130–2440 m), 15 August 1945, *R. R. Stewart* 21706 (K!, PE!); **29** Meenamarg, east side of Zoji La pass, 3250 m, 26 August 1977, *C. R. Fraser-Jenkins* 6522 (BM!); **32** Satrundi, north of Tissa, north-west of Chamba, 3300 m, 10 September 1978, *C. R. Fraser-Jenkins* 7832, 7833 (BM!), 7832, 7833, 7835, 7837 (H!); **35** Parbati valley, Kulu Distr., 17 July 1952, *E. Schelpe* 3534 (BM!); **36** Lahoul, Sisu, 11,000 ft (3340 m), 24 July 1930, *W. N. Koelz* 642 (MICH!, PE!); **37** Huttoo peak, Simla, 10,500 ft (3190 m), 28 August 1960, *S. S. Bir* 1496 (PAN 4002!); **39** Jaunsar, 7000 ft (2130 m), June 1891, *J. S. Gamble* 23541 (K!) and Deoband, Jaunsar, *C. E. Parkinson* (CAL!); **40** Nag Tibba, 8500 ft (2590 m), 29 September 1949, *R. B. Parker* 72 (MICH!); **41** Gangotri, 11–12,000 ft (3340–3640m), 5 October 1881, *J. F. Duthie* 28 (P!); **42** Trijugi Naryan to Mongu, north of Rudraprayag, 3300 m, 25 October 1978, *C. R. Fraser-Jenkins* 8372, 8373 (BM!); **43** Hanuman Chatti, Badrinath, 3300 m, 17 September 1977, *C. R. Fraser-Jenkins* 7264, 7265 (BM!, PE!); **47** 'Nynee Tal', *Col. Dyas* 60 (BM!); **48** Dhauli Valley, 'Kumaon', 11–12,000 ft (3340–3640 m), 3 September 1884, *J. F. Duthie* 3671 (BM!); **51** Near Maharigaon, 13,500 ft (4090 m), 17 July 1952, *O. Polunin, W. R. Sykes & L. H. J. Williams* 1571 & 182 (BM!, E!); **53** Tarakot, 82° 45′E, 28° 57′N, 2900 m, 30 June 1973, *S. Einarsson, L. Skärby & B. Wetterhall* 1386 (BM!); **54** Chimgaon, north of Tukucha, Kali Gandaki, 4 June 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 923 (BM!, E!); **55** Near Ghustung Khola, 9500 ft (2890 m), 6 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 3389 (BM!, E!); **57** Shiar Khola, west of Chumpi, 10,500 ft (3190 m), 28 June 1953, *P. C. Gardner* 957, 966 (BM!); **59** Langtang, 4000 m, 7 August 1970, *J. F. Dobremez* 516 (KATH!); **60** Imja Khola rivière, rive gauche, sous Thyangboche, 20 October 1954, *A. Zimmermann* 1776 (BM!); **62** Thudam, 3400 m, 22 June 1972, *H. Kanai et al.* 72546 (KATH!); **64** Sandakphoo, Darjeeling, 12,000 ft (3640 m), August 1956, *D. S. Loyal* (PAN 1426, 1430!); **65** Above Lachen, 9000 ft (2740 m), July 1958, *D. S. Loyal* (PAN 2515–2518!); **66** Yatung, 11,000 ft (3340 m), 13 June 1945, *N. L. Bor & K. Ram* 20199 (BM!); **68** Wortheng, 16 July 1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 16874 (BM!).

Notes: This species is somewhat variable in size and scale colour, probably due to its apomictic nature. Some of the minor variants or even mere local collections have recently been named as species by Ching (1983) though the range of variation is continuous and not of taxonomic significance. Although Clarke (1880) described his var. *fibrillosa* as having chestnut-coloured scales, it is clear from the rest of his description and from his specimens at Kew and elsewhere

that he was referring mainly to the blackish-chestnut scaled plants that constitute the present species. A lectotype is therefore chosen to typify var. *fibrillosa* as the present species rather than *D. redactopinnata*, a few specimens of which at Kew he had also labelled as var. *fibrillosa*.

Several authors publishing on the ferns of the Indian subcontinent have referred to this species as *Dryopteris rosthornii* (Diels) C. Chr., but the type of *D. rosthornii* (China, 'Setchuen', 1733, *C. Bock & A. von Rosthorn* 27 (O!)) represents a distinct species almost confined to west China (Yunnan, Szechuan, Hupeh, Shensi, Kansu, Fukien). The type of *D. xanthomelas* (Christ) C. Chr. (western China, [Mt Omei], July 1903, *E. H. Wilson* 5371 (P! – lectotype, selected here; BM!, K! – isolectotypes)) appears very close to *D. pulcherrima*, but is actually a plant of *D. rosthornii* with fewer of the long and very narrow rachis scales than normal. For some time the present author erroneously thought that it was referable to the present species.

The specimens of *Dryopteris pulcherrima* cited by Ching (1938) are a mixture of *D. rosthornii*, *D. polylepis*, and the present species from the drier areas of north-west China, but the type is the present species, so the name is used here for the first time for the Indian subcontinent.

Dryopteris pulcherrima appears to be distantly related to *D. wallichiana* and could represent a species that diverged from it in response to the formation of the high-level Himalayan environment during the Tertiary period. Its smaller size and segments, and greater fibrillosity are features shared by many high-level species. *D. redactopinnata* is also close to *D. pulcherrima* but is intermediate between it and *D. wallichiana* in most respects. All three have the same chromosome number and are apomictic, but are clearly separated as species. Widén et al. (in prep.) have recently found in a preliminary study that there are differences in phloroglucide content between Himalayan *D. pulcherrima* and *D. wallichiana*, and that *D. redactopinnata* is chemically similar to *D. wallichiana*.

9. Dryopteris neorosthornii Ching **Fig. 11**

in *Bull. Fan meml Inst. Biol.* (Bot.) **11**: 62 (1941). Type: China, NW. Yunnan, A-tun-tze [= Yungtze], Dechin [= Tzechung], a Tibetan village, about one day's journey north of Tzechung on the west bank of the Mekong river, 2800–3100 m, 7 August 1940, *K. M. Feng* 6396 (PE! – holotype; PE! – isotype).

Fronds medium to large (up to *c.* 100 cm long), forming a drooping shuttlecock. Stipe somewhat short to medium-length, up to *c.* ⅕ the length of the lamina, the base densely clothed with widely

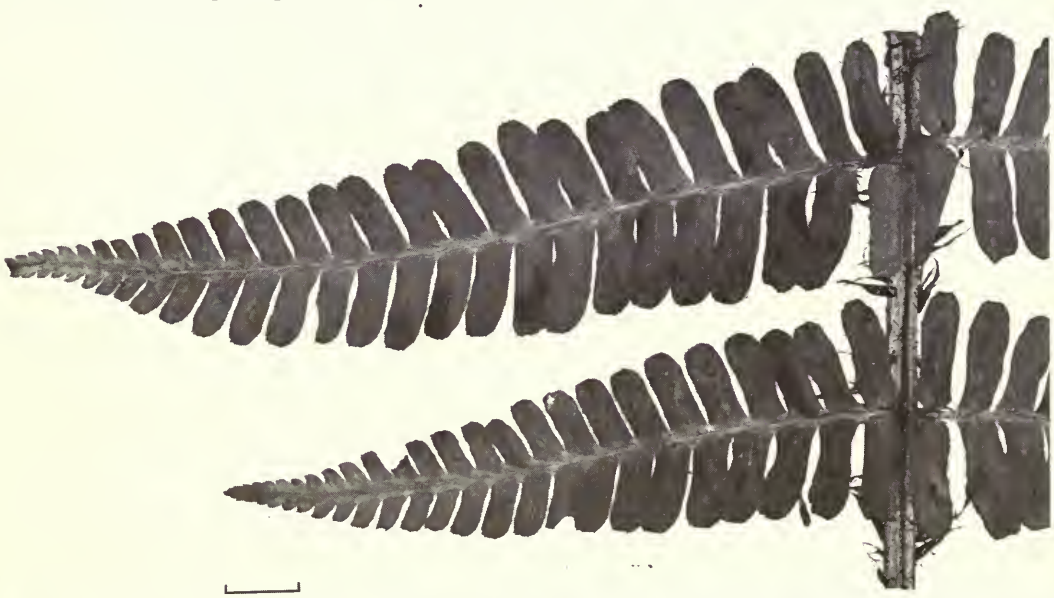

Fig. 11 *Dryopteris neorosthornii*. India, Uttar Pradesh, Chamoli, north of Rudraprayag, west of Sonprayag, Trijugi Naryan to Mongu, 25 October 1978, *C. R. Fraser-Jenkins* 8366 (BM). Scale line = 1 cm.

ovate-lanceolate, thick, glossy, black scales, which become slightly smaller and less dense, but remain somewhat wide further up, with scattered, adpressed, small, narrowly-lanceolate or hair-like, paler scales or fibrils between them; rachis clothed with somewhat scattered, short, somewhat wide, partly deciduous, glossy, black scales and scattered, short, very narrow or hair-like, pale brown or pale fibrils. Lamina once pinnate, a second time pinnatifid, becoming twice pinnate below, lanceolate (up to *c.* 24 cm wide), somewhat tapering downwards towards a slightly widely truncate base, bearing many (up to *c.* 37 pairs) ± contiguous, narrow, regular pinnae; pinnae linear, slightly coriaceous, the upper surface mid- to dark green and somewhat glossy, bearing a few scattered, short, hair-like, brown or grey fibrils on the costae, costules, surfaces and edges, mostly deciduous with age, pinnae bearing numerous (up to *c.* 21 pairs) regular, medium-sized, ± rectangular lobes or pinnules, which become markedly longer than broad about the middle of the frond and do not become developed on the basiscopic side of the lower pinnules; pinna-lobes or pinnules larger than in *D. pulcherrima* or *D. redactopinnata*, usually being nearly as large as those of *D. wallichiana*, markedly parallel-sided and unlobed in the lower pinnae, apart from an auricle at the basiscopic base of the basal pair of pinnules on each pinna, but sometimes shallowly lobed at the sides towards the pinnule apices in the mid-upper pinnae, apices rounded-truncate or rounded and sometimes very slightly spathulate, almost toothless, or bearing a few insignificant, short, acute teeth. Sori in two rows, one on either side of the centre of the pinnule, indusiate; indusia thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores irregular, with fully formed and a minority of abortive spores.

Cytology: Triploid apomict (E. Himalaya: Gibby (1985)).

Ecology: A species of the upper-level forest zone, growing on the ground, from *c.* 2500–3500 m alt.

Range: India (eastern parts of the W. Himalaya; E. Himalaya in Sikkim); Nepal; SE. Tibet; China (Yunnan, Szechuan). Apparently not collected from Bhutan or North Assam. An uncommon Sino-Himalayan species of the widespread sort.

Range in the Indian subcontinent: **41** Masarital, Dharm to Ganga valley, 30 September 1974, *M. V. Viswanathan* 55167 (BM!, BSD!); **42** Trijugi Naryan to Mongu, Gaurikund, south-west of Kedarnath, 3300 m, 25 October 1978, *C. R. Fraser-Jenkins* 8363, 8364, 8371 (H!), 8364 (PE!), 8365–8367 (BM!); **43** Bhuna to Bishtola, Garhwal, *M. A. Rau* 10254 (CAL!); **49** Doti to Khaptad, 3000 m, 3 August 1972, *M. S. Bista & D. P. Joshi* 256 (KATH!); **59** Serpagaon to Lama Lodge, Langtang, 2500 m, 3 October 1977, *V. L. Gurung & party* 77/693 (KATH!); **64** Sandakphoo, Singalilla, Darjeeling, 12,000 ft (3640 m), 21 October 1980, *C. R. Fraser-Jenkins* 10304, 10305 (BM!).

Notes: This species is reported from the Indian subcontinent for the first time here. It is close to *Dryopteris pulcherrima* but is larger and has larger segments (similar in size to those of *D. wallichiana* but with more rounded apices); the wide, dark scales are also a distinctive feature. Preliminary results of chemical analysis of the phloroglucides (Widén et al., in prep. and pers. comm. 1981) show that it is similar to *D. pulcherrima*.

10. Dryopteris redactopinnata S. K. Basu & Panigr. **Fig. 12**

in *Indian J. For.* **3** (3): 270 (1980). Type: India, Kashmir, Gulmarg, 7000 ft (2135 m), 21 July 1891, *G. A. Gammie* (CAL 16268! – holotype; CAL 16267! – isotype).

Dryopteris tsangpoensis Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 250 (1983). Type: Tibet, Kongbo province, valley above Tse, Tsangpo valley, 10,500 ft, 4 June 1938, *F. Ludlow, G. Sherriff & G. Taylor* 4650 (PE! – holotype; BM! – isotype).

Dryopteris pseudofibrillosa Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 252 (1983). Type: Tibet, Mainling, 3000 m, Tibet Medicinal Herb. 3911 (PE! – holotype; PE! – isotype).

Fronds medium-sized to large (up to *c.* 100 cm long), forming almost perfect shuttlecocks. Stipe short, up to *c.* ¼ the length of the lamina, stipe-base very densely clothed with ovate-lanceolate, very dark, smokey-brown or blackish scales (occasionally paler or all dark), usually with pale yellowish grey-brown apices, at least in the upper part of the stipe and lower part of the rachis,

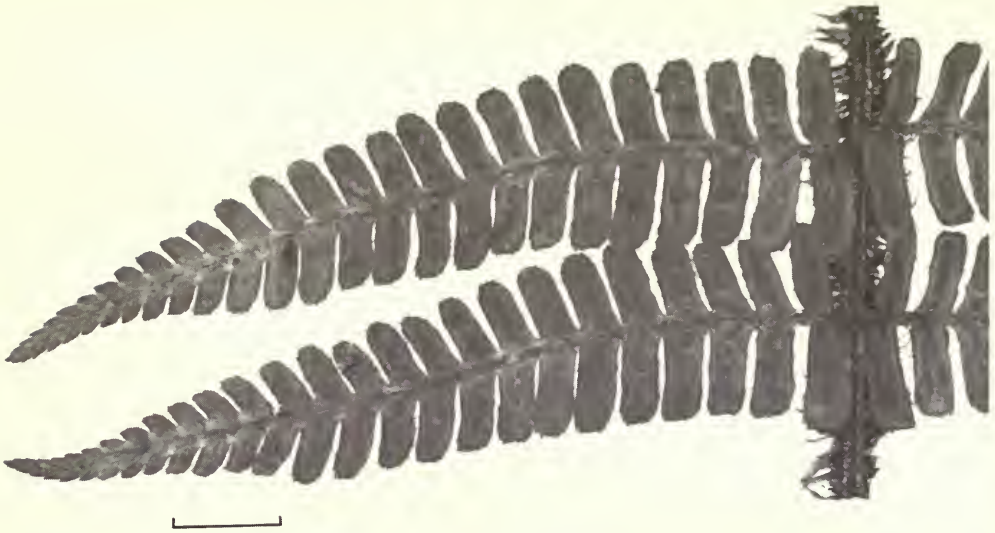

Fig. 12 *Dryopteris redactopinnata.* India, Himachal Pradesh, east of Simla, Jubbal, Chhachpur, 22 September 1980, *C. R. Fraser-Jenkins, S. P. Khullar & J. B. S. Oberoi* 10260 (BM). Scale line = 1 cm.

the dark colour often extending towards the apex in streaks, the rest of the stipe densely clothed in long, lanceolate scales with dark bases, but usually becoming mid-brown to pale grey-brown in their upper halves; rachis densely clothed in long, narrowly lanceolate scales, varying from mostly dark to mid-brown, often with darker bases than apices, intermixed with some very narrow, hair-like ones. Lamina once pinnate, a second time pinnatifid, nearly becoming twice pinnate at the bases of the lower-middle pinnae, narrowly lanceolate (up to *c.* 25 cm wide), gradually tapering towards a markedly narrow base, bearing many (up to *c.* 40 pairs) ± contiguous, narrow, regular pinnae; pinnae linear, slightly coriaceous, the upper surface slightly glossy and mid-green (yellow-green when young), bearing small, scattered, very narrow, hair-like, pale brown fibrils on the costae, costules, surfaces and edges, though these are mostly deciduous as the frond ages, pinnae bearing numerous (up to *c.* 20 pairs) highly regular, crowded, small, rectangular lobes, and not becoming developed on the basiscopic side of the lower pinnae; pinna-lobes joined only at their bases, markedly parallel-sided apart from a basal auricle on the basiscopic side of the basal pair of lobes on each pinna, occasionally bearing small lobes at the sides towards their apices in the mid-upper parts of the frond, pinna-lobe apices ranging from markedly truncate to rounded-truncate, bearing a few small, acute crenations or teeth. Sori in two rows, one on either side of the centre of the pinna-lobe, indusiate; indusia thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores irregular, with fully formed and a minority of abortive spores.

Cytology: Diploid (W. Himalaya: Gibby (1985)).

Ecology: A species of the upper-level forest zone, growing on the ground, from *c.* 2000–3300 m alt.

Range: Pakistan (Himalaya east of the Indus); India (W. Himalaya); China (Yunnan, Szechuan); Taiwan; SE. Tibet. A Sino-Himalayan species of the west Himalayan sort in the Indian subcontinent, with interesting disjunct populations in SW. China and Taiwan, in common with several other west Himalayan species.

Range in the Indian subcontinent: **20** Sharhan, Kagan, 14 June 1899, *Inayat* 23224 (BM!, DD!, E!); **24** Fras Nag, Pir Panjal, 8–10,000 ft (2440–3040 m), 27 July 1947, *R. R. Stewart* 23210 (PE!, RAW!); **25** Lolab valley, Andrbug, October 1891, *R. W. Macleod* (RAW!); **26** Pahlgam, September 1955, *T. C. Mittal* 74 (PAN 3098, etc.!); **28** Upper Chenab, 7000 ft (2130 m), October 1893, *J. C. McDonell* (DD!); **32** Sara,

Chumba, 10,000 ft (3040 m), 8 October 1874, *C. B. Clarke* 24134 (BM!); **33** Dharmsala, 10,000 ft (3040 m), 16 October 1874, *C. B. Clarke* 24517 (BM!); **35** Pulga, Parbatti valley, Kulu, 9000 ft (2740 m), 7 June 1934, *C. E. Parkinson* (DD!); **37** Kamalhori Mt, Simla, Mathiana to Narkanda, 9800 ft (2980 m), 31 August 1886, *C. W. Hope* 44, 250 (BM!, DD!, P!); **39** Deoband, Jaunsar, 1936, *C. E. Parkinson* (CAL!, DD!), with *D. pulcherrima* and *D. wallichiana*; **41** Ganges valley, Tehri Garhwal above Harsil (CAL!), **42** Deota, Tehri Garhwal (CAL!); **43** Hanuman Chatti, Badrinath, 3300 m, 17 September 1977, *C. R. Fraser-Jenkins* 7268 (BM!), 7269 (PE!, Herb. T. Reichstein, Basel!); **45** 'Kamaon', *W. Griffith* (K!).

Notes: Dryopteris redactopinnata was described mainly in order to distinguish between plants of *D. wallichiana* with wider lamina-bases and those with narrower ones (Panigrahi, pers. comm. 1980). All the specimens cited in the original account, except for the holotype and isotype, are plants of *D. wallichiana* not markedly different from normal, but which Basu and Panigrahi had distinguished from what turned out to be a mixture (shown to the present author at CAL) of *D. lepidopoda*, *D. madrasensis*, and large fronds of *D. wallichiana*, which together constituted the authors' concept of *D. wallichiana*. The difference between wider and narrower lamina-bases on the scale they observed is not significant in *D. wallichiana*. However, the type specimen they selected was, fortuitously, a specimen of the present species which happens to fit their concept better than any of the other specimens they cited. Some other specimens of the present species exist at CAL but were not cited in their paper.

Dryopteris redactopinnata is intermediate in morphology between *D. pulcherrima* and *D. wallichiana* with the smaller pinnule-size, more hairy lamina and darker stipe-base scales of the former, but the larger frond size and usually browner upper stipe scales of the latter. It is not a spontaneous hybrid between the two species, but a distinct species with its own west Himalayan (and eastern) distribution pattern and distinctive morphology. Preliminary results on the phloroglucide content (Widén et al., in prep. and pers. comm. 1981) show that *D. redactopinnata* is similar to *D. wallichiana*, rather than to *D. pulcherrima*, from which species darker-scaled specimens of *D. redactopinnata* can be a little difficult to distinguish.

11. **Dryopteris yigongensis** Ching **Fig. 13**

in Cheng-yih Wu, *Fl. xizangica* **1**: 253, fig. 60, 1–3, pl. 6, 5–6 (1983). Type: Tibet, Pome, Yikung, 2500 m, 15 July 1965, *Ying, Jung-Sen* 0574 (PE! – holotype; PE! – isotype).

Fronds somewhat small (up to *c.* 60 cm long). Stipe ± long, up to *c.* ½ or more the length of the lamina, stipe-base densely clothed with lanceolate, glossy, black scales, sometimes with somewhat paler margins and apices, the rest of the stipe bearing shorter, scattered, narrowly lanceolate, glossy, dark brown to black scales, sometimes with paler apices, and densely clothed with somewhat small but very obvious, adpressed, hair-like, grey or grey-brown fibrillae; rachis similar, but bearing fewer and smaller lanceolate scales. Lamina once pinnate, a second time pinnatifid, becoming twice pinnate below, lanceolate to narrowly triangular-lanceolate (up to *c.* 18 cm wide), not, or only very slightly tapering downwards to a truncate base, bearing many (up to *c.* 25 pairs) ± contiguous, somewhat short pinnae; pinnae slightly coriaceous, somewhat glossy, dark green above, bearing many scattered, narrowly hair-like, semi-deciduous, pale brown fibrillae, mainly on the costae and costules, but also on the lamina, and bearing numerous (up to *c.* 13 pairs) regular, somewhat small, ± rectangular lobes, slightly longer than broad, the lowest pair or two pairs of pinna-lobes on lower pinnae being fully separated into pinnules; the lowest pairs of pinnules on the lowest pairs of pinnae having a narrow base or becoming ± stipitate, others widely attached, pinnules and pinna-lobes markedly parallel-sided and unlobed except for the lower basiscopic pinnules on the lowest pair of pinnae which become slightly developed and usually shallowly lobed in well-developed plants, apices rounded-truncate, becoming more rounded or obtusely pointed in the lower pinnae in well-developed plants, bearing small, ± insignificant, acute teeth. Sori in two rows, one on either side of the centre of the pinnule or pinna-lobe, indusiate; indusia somewhat thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores irregular, with fully formed and a minority of abortive spores.

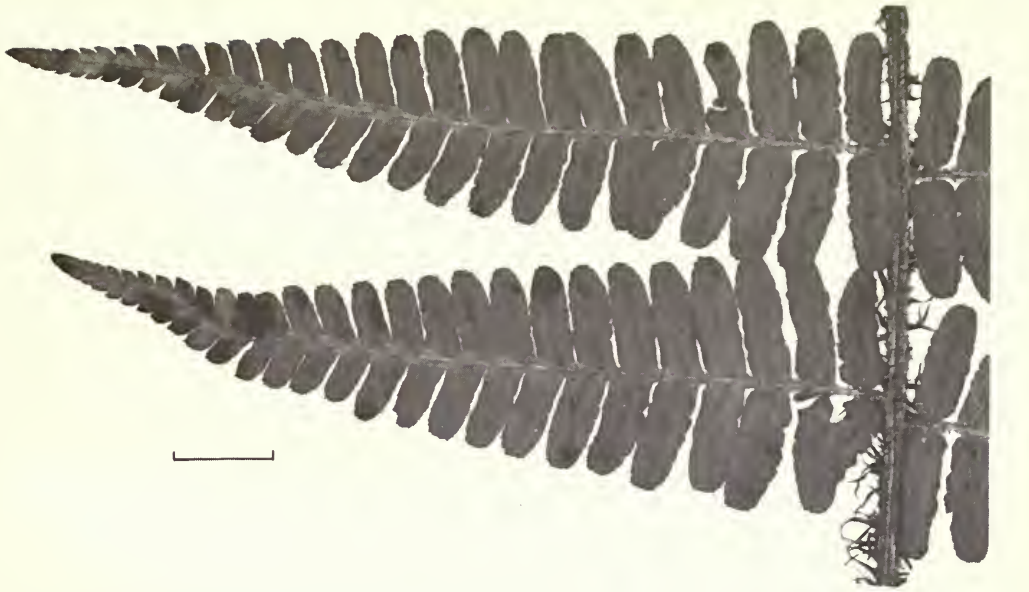

Fig. 13 *Dryopteris yigongensis*. India, Himachal Pradesh, Simla, Narkanda, Mt Hattu, 26 August, 1978, *C. R. Fraser-Jenkins* 7659 (PE). Scale line = 1 cm.

Cytology: Triploid apomict (W. Himalaya: Gibby (1985). Khullar, ined., voucher specimen, *S. P. Khullar* 83, July 1966 (PAN 5439!)).

Ecology: A species of the upper-level forest zone, growing on the ground, from *c.* 2500–3000 m alt.

Range: India (W. Himalaya); SE. Tibet; China (Yunnan, Szechuan, Hunan). A Sino-Himalayan species of the west Himalayan sort in the Indian subcontinent, also occurring in SW. China.

Range in the Indian subcontinent: **24** Gulmarg, 2700 m, July 1966, *S. P. Khullar* 83 (PAN 5439!); **26** Pahlgam, 1945, *R. R. Stewart* (RAW!); **32** Ravi valley, below Salrundi [= Satrundi, north of Tissa], 9000 ft (2740 m), 1882, *J. S. Gamble* 57 (K!); **35** Above Manali, Rohtang Pass, Kulu valley, 2700 m, 2 September 1977, *C. R. Fraser-Jenkins* 6806, 6808, 6854 (BM!), 6855, 6856 (PE!); **37** Mt Hattu, Narkanda, Simla area, 3000 m, 6 September 1977, *C. R. Fraser-Jenkins* 7014, 7017 (Herb. T. Reichstein, Basel!), 7015, 7016 (BM!), 7015–7017 (PE!), 26 August 1978, *C. R. Fraser-Jenkins* 7551, 7552, 7561, 7584, 7652, 7654, 7661 (BM!), 7584, 7589, 7610, 7617, 7632–7634, 7643–7645, 7648, 7652, 7654–7656, 7658 (H!), 7585, 7586, 7609, 7655, 7659 (PE!), and above Panju, valley south of Chhachpur, Jubbal, east of Simla, 9000 ft (2740 m), 22 September 1980, *C. R. Fraser-Jenkins* 10229, 10246 (BM!), *S. P. Khullar & J. B. Oberoi*, and head of Chhachpur valley, above Onti, Jubbal, Simla, 7500 ft (2290 m), 23 September 1980, *C. R. Fraser-Jenkins* 10232 (BM!), *S. P. Khullar & J. B. Oberoi*; **43** Badrinath, 1982, *S. P. Khullar* 5211 (PAN!). Also, unlocated: Kashmir, 7000 ft (2130 m), *R. R. Stewart* 5324A (PE!).

Notes: For some time the present author was under the impression that this was a new species, having discovered it independently of Ching, in the west Himalaya. However, careful study and comparison with the somewhat poor and difficult type material of *Dryopteris yigongensis* Ching has convinced the author that it must represent the same species, of which a few other specimens from Yunnan also exist in Peking (PE!) under various different manuscript names. Several of the present author's west Himalayan collections match the type of *D. yigongensis* exactly. This species is presumably related to *D. pulcherrima*, but can be distinguished by its longer stipe, wider frond base and more densely fibrillose upper stipe; the lowest pinnules are also more stalked. It appears on morphological grounds to have been derived from *D. pulcherrima* and a member of some other section at some stage in the past. Some plants are also somewhat close to

D. lepidopoda, at least to young plants of the latter, but can be distinguished by their narrower, more fibrillose lamina and wider stipe and rachis scales, and their less prominently veined, usually narrower pinnules which have less prominent teeth, a softer texture and less truncate pinnule apices. It appears that the west Himalayan plants treated here as *D. yigongensis* may well constitute two distinct species. One, corresponding with the type of *D. yigongensis*, has slightly more truncate and less deeply lobed, or developed lower pinnules. The other, which is at present undergoing further study and will, if clearly distinct, be named as a new species, has slightly more pointed and deeply lobed pinnules and a more developed and longer lowest basiscopic pinnule, which is fully stipitate and less close to the pinna-costa; it also has a markedly less densely fibrillose rachis. Whereas true *D. yigongensis* is morphologically closer to *D. pulcherrima*, the new species is slightly more intermediate towards *D. juxtaposita*. When they were first collected the two were assumed by the present author to be two different new species, with the field code-names, 'Hattu 1 species' (= *D. yigongensis*) and 'Hattu 2 species' (= new species), but both were found to be triploid apomicts and a preliminary comment on their phytochemistry (Widén, pers. comm. 1981) suggested that their phloroglucides were similar. When a few possible intermediate plants were examined morphologically it was assumed that the two were extremes of the range of variation within one species, which it then became clear was *D. yigongensis*. However, their chemistry (Widén et al., in prep.) is not as similar as was first thought but differs in some qualitative respects which, more importantly, correspond with the two types of morphology. It therefore seems likely that the two are indeed distinct. Of the specimens seen or cited, only the Mt Hattu population contains some specimens (*C. R. Fraser-Jenkins* 7647, 7652, 7654–7661) which are the new species.

12. **Dryopteris acuto-dentata** Ching **Fig. 14**

in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 432 (1938). Type: India, below Salrundi [Satrundi], Ravi valley, 9500 ft, 1882, *J. C. McDonell* 49 (K! – lectotype, selected here).

Nephrodium kingii C. Hope in *J. Bombay nat. Hist. Soc.* **12**: 621, pl. 9 (1899). – *Dryopteris filix-mas* subsp. *kingii* (C. Hope) C. Chr., *Index filic.*: 265 (1905) [non *Dryopteris kingii* (Beddome) C. Chr. (1905)]. Type: as for *Dryopteris acuto-dentata*.

Dryopteris silaensis Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **11**: 65 (1941). Type: China, Yunnan, Sila Pass [on the Mekong–Salwin divide, one day's journey to the N.W. of Tzechung on the west bank of the Mekong river], 3400–3500 m, 14 July 1940, *K. M. Feng 5421* (PE! – lectotype, selected here; PE! – isolectotype).

Fronds ± small (up to *c.* 45 cm long). Stipe ± long, up to *c.* ⅓ the length of the lamina, stipe-base densely clothed with thin, ovate-lanceolate, wrinkled, glossy, dark brownish-black or black scales, the rest of the stipe and the rachis bearing more scattered, smaller, lanceolate, thin, dark scales, stipe and rachis scales partially deciduous, especially on drying. Lamina becoming twice pinnate below, very narrowly triangular-lanceolate (up to *c.* 10 cm wide), truncate at the base and not, or only very slightly tapering downwards, bearing many (up to *c.* 15 pairs) somewhat distant, markedly short pinnae; pinnae triangular-lanceolate, slightly crispaceous, the upper surface slightly glossy, mid- to dark green, bearing a few small, deciduous, blackish, lanceolate scales on the under-surface of the costae near their bases, and bearing several (up to *c.* 8 pairs) ± rectangular, usually somewhat crowded lobes which are noticeably longer than broad, the lowest pair or two pairs of lobes on lower pinnae being fully separated into pinnules and sometimes slightly developed and longer on the basiscopic side of the lower pinnae; the lowest pair of pinnules on the lowest pairs of pinnae having a narrow base or even becoming fully stipitate, the others widely attached to the costae; pinnules and pinna-lobes parallel-sided, ranging from unlobed to irregularly lobed up to half the depth of the pinnule on each side, the lobes bearing a few teeth, pinnule-apices rounded-truncate or rounded, bearing long-acute, often slightly aristate teeth around the apex. Sori in two rows, one on either side of the centre of the pinnule or pinna-lobe, indusiate; indusia somewhat thick, becoming brown and lifting and shrivelling slightly, mostly deciduous. Spores irregular, with fully formed and a minority of abortive spores.

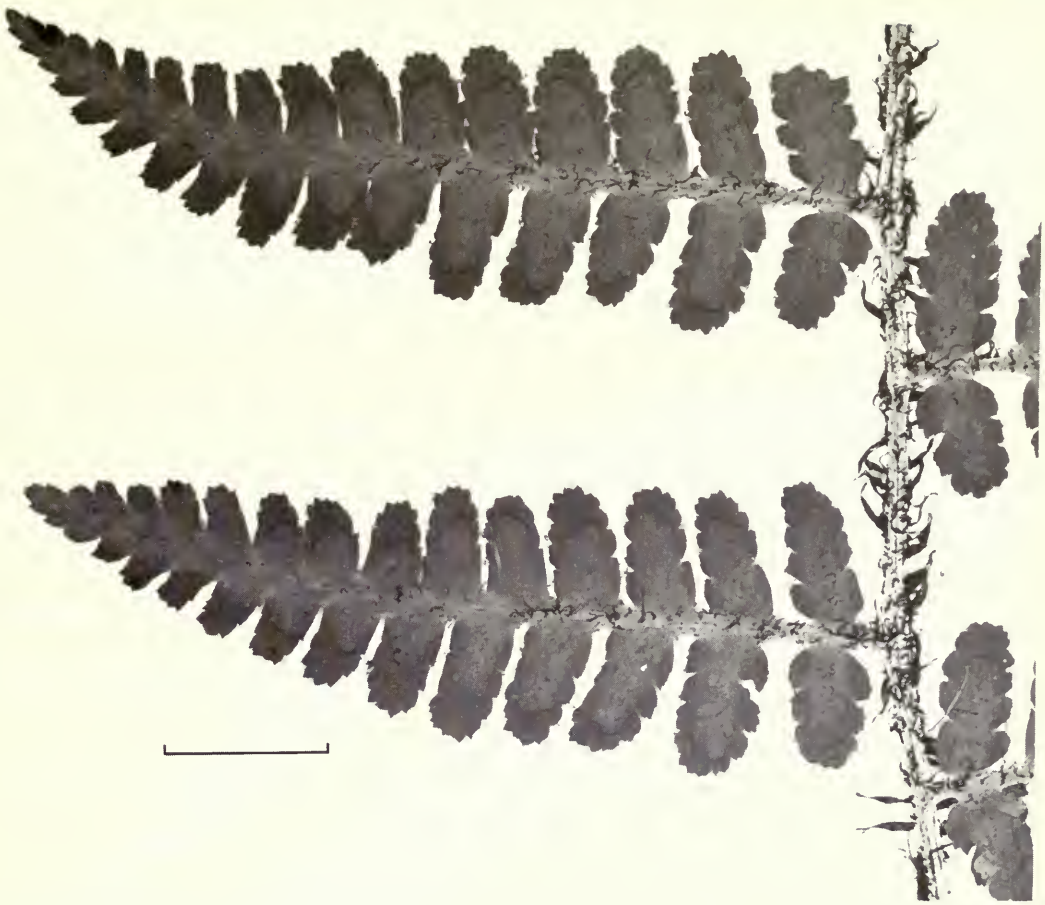

Fig. 14 *Dryopteris acuto-dentata.* India, Himachal Pradesh, north-west of Chamba, Tissa, Satrundi, 10 September 1978, *C. R. Fraser-Jenkins* 7800 (H). Scale line = 1 cm.

Cytology: Triploid apomict (E. Himalaya: Loyal in Mehra (1961), sub *D. serrato-dentata* part. Mehra & Loyal (1965), sub *D. serrato-dentata* ('Triploid cytotype'), voucher specimens, *D. S. Loyal*, August 1955 and 45, 12 August 1956 and September 1958 (PAN 1172!, 2222!, 2223!, 3207!). Gibby (1985)).

Ecology: A species of the Himalayan scrub zone (above the forests), growing on the ground beside rocks, from *c.* 3000–4000 m alt.

Range: India (W. Himalaya; E. Himalaya in Sikkim and N. Assam); Nepal; S. and SE. Tibet; China (Yunnan, Szechuan). Apparently not collected from Bhutan or N. Burma. A Sino-Himalayan species of the Tibetan sort.

Range in the Indian subcontinent: **32** 2 km below Satrundi, north of Tissa, north of Ravi valley, 3300 m, 10 September 1978, *C. R. Fraser-Jenkins* 7796 (PE!), 7797, 7799 (BM!), 7797–7806 (H!); **35** Kulu, Chandra Kani, 11,000 ft (3340 m), 29 June 1930, *W. N. Koelz* 235 (PE!); **36** Lahul, Shipting Nullah, 11,000 ft (3340 m), 4 August 1930, *W. N. Koelz* 945 (PE!); **37** Above Simla, *Col. Bates* (BM!, K!); **41** Damdar valley, Tehri Garhwal, nr Jamara camping ground, 11–12,000 ft (3340–3640 m), 26 June 1883, *J. F. Duthie* 121 (DD!, K!); **57** Chilime Kharka, 13,000 ft (3940 m), July 1949, *O. Polunin* 1196 (BM!); **59** Dupuk, Helumbu, 11,500 ft (3490 m), July 1964, *R. L. Fleming* 1823 (MICH!); **60** Gokyo, Everest, 14,000 ft (4240 m), October 1977, *R. L. Fleming* 2379 (MICH!), and Bharate Himal, Barun valley, near the Ne pasture, 3900 m, 8 October 1972, *T. Wraber* (34720) 413 (BM!); **64** Sandakphu, Darjeeling, 12,000 ft (3640 m), 12 August 1956, *D. S. Loyal* 45 (PAN 2222!, 2223!); **65** Sikkim, 11,000 ft (3340 m), September 1955, *D. S.*

Loyal 68 (BM!, PAN 855!); **66** Yatung, Chumbi valley, 10,000 ft (3040 m), 20 June 1945, *N. L. Bor & K. Ram* 20490 (BM!); **74** Tawang subdiv., on way to Bumla pass, Bomdila, *P. Chandra* 80408 (LWG!).

Notes: Loyal in Mehra (1961) and Mehra & Loyal (1965) report *Dryopteris acuto-dentata* as a diploid sexual species. However, this must be erroneous, as their voucher specimen (*Loyal* 68 (PAN 855!, BM!)), which is correctly identified, has large, partially abortive spores (typical of *D. acuto-dentata*). The voucher specimens of what they reported as the triploid cytotype of *D. serrato-dentata* are also *D. acuto-dentata*.

Dryopteris acuto-dentata is intermediate in morphology between *D. pulcherrima* and a species such as *D. alpestris* or *D. barbigera* subsp. *komarovii*. The author has been unable to find a specimen cited by Ching (1938), following Hope, from Dungboo and Dotho (*King's collector* 4683), as one of the type specimens.

13. **Dryopteris lepidopoda** Hayata **Fig. 15**

Icon. pl. formos. **4**: 161, fig. 101 (1914). Type: Taiwan, Arisan, January 1912, *B. Hayata & S. Sasaki* (TI! – holotype).

Nephrodium filix-mas var. *khasiana* C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 519, pl. 69, fig. 1 (1880). – *Nephrodium parallelogrammum* forma *khasiana* (C. B. Clarke) C. Hope in *J. Bombay nat. Hist. Soc.* **14**: 729 (1903). – *Dryopteris paleacea* var. *khasiana* (C. B. Clarke) C. Chr. in *Contr. U.S. natn. Herb.* **26**: 280 (1931). Type: India, Nongbri, Khasia, 4500 ft, 3 November 1879, *C. B. Clarke* 18746 (K! – lectotype, selected here).

Dryopteris nigra Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 430 (1938). Type: as for *Nephrodium filix-mas* var. *khasiana*.

Dryopteris taiwanicola Tag. in *Acta phytotax. geobot. Kyoto* **8**: 230 (1939). Type: Taiwan, Prov. Tainan, inter Tâtaka et Numanohira (Mt Arisan), 15 August 1934, *M. Tagawa* 356 (KYO! – lectotype, selected here; MICH! – isolectotype).

Dryopteris longistipes Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **11**: 59 (1941). Type: China, Yunnan, NW. Likiang, [mountains south of] Kai-Tze on Yangtze, 2500–2600 m, 26 December 1939, *K. M. Feng* 2620 (PE! – lectotype, selected here; PE! – isolectotypes).

Dryopteris latibasis Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **11**: 61 (1941). Type: China, NW. Yunnan, NW. Likiang, [mountains south of] Kai-Tze on Yangtze, 2500 m, 26 December 1939, *K. M. Feng* 2619 (PE! – lectotype, selected here; PE! – isolectotype).

Dryopteris junlianensis H. S. Kung in *Acta bot. yunnan.* **4** (4): 340 & pl. (1982). Type: China, Sichuan, Junlian, 1100 m, *H. S. Kung* 5168 (Herb. Inst. Forestry Sichuan – holotype, only photograph seen).

Dryopteris lepidopoda var. *phaeocoma* Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 258 (1983). Type: Tibet, Tingkye, 2300 m, 6 June 1975, *Chinghai-Xizang Expedition* 5547 (PE! – holotype; PE! – isotype).

Dryopteris neolepidopoda Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 258, fig. 61, 1–2 (1983). Type: Tibet, Cha Yü, Dao Cha Yü, Sa Kung Ho, 2300 m, 14 July 1973, *Chinghai-Xizang Expedition* 73-687 (PE! – holotype).

Misapplied name: Dryopteris patentissima sensu Nair (1968), Panigrahi & Basu (1980).

Fronds large (up to *c.* 120 cm long), spreading. Stipe somewhat thin, very long, ½ to about the same length as the lamina, stipe-base densely clothed with long, lanceolate scales with long attenuate apices, becoming markedly narrowly lanceolate above the very base and remaining long and dense, very rarely a few slightly wider scales extending up to half the length of the stipe (in half-buried plants), scales varying from very dark or black to mid-brown in occasional specimens. Lamina twice pinnate below, elongated triangular-lanceolate or lanceolate (up to *c.* 30 cm wide), untapered or very slightly tapered to a widely truncate base, bearing many (up to *c.* 35 pairs) ± contiguous, narrow, regular pinnae; pinnae mostly linear except for the lowest ones in more foliose plants which may become somewhat developed on their basiscopic side, noticeably coriaceous or slightly crispaceous, the upper surface somewhat glossy and mid-green (pinkish-yellow when young), bearing a few small, scattered, very narrow, hair-like, pale brown fibrils, mostly on the costae and costules and mostly dropping off as the frond becomes mature; bearing numerous (up to *c.* 25 pairs) regular, small to medium-sized, rectangular lobes, which often become somewhat longer and developed on the basiscopic side of the lowest few pinnae, but the lowest pair of pinnules on the lowest pair of pinnae normally reduced in size, pinna-lobes

or pinnules similar in size to *D. wallichiana* or frequently longer, joined only at their bases and becoming separated into pinnules at the bases of the lower pinnae, but lowest pair of pinnules on the lowest pair of pinnae very narrowly attached to the costa or nearly stipitate, pinnules markedly parallel-sided and usually unlobed except when the basiscopic ones in lower pinnae are well-developed, in which case they are often shallowly lobed at the sides with rectangular lobes, pinnule apices ranging from rounded-truncate to obtusely pointed, the latter condition more frequent in the lower pinnae when the lowest basiscopic pinnules are extended, bearing very regular, small, narrowly triangular-lanceolate and somewhat stiff, acute teeth. Sori in two rows, one on either side of the centre of the pinnule, indusiate; indusia thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores irregular, with fully formed and a minority of abortive spores.

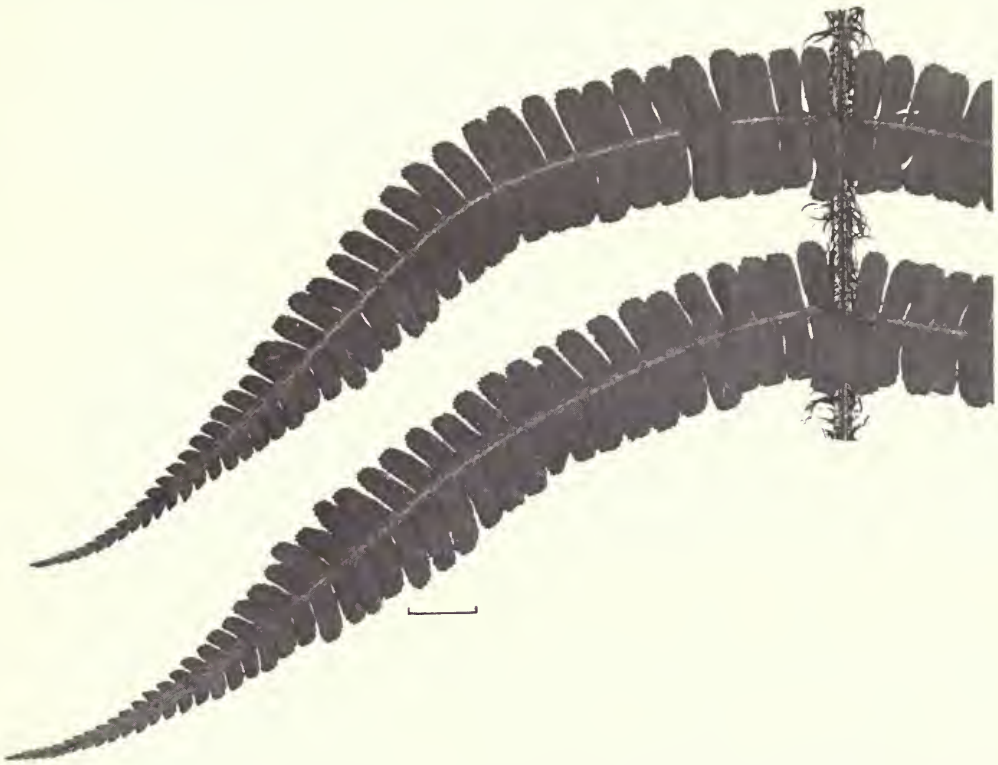

Fig. 15 *Dryopteris lepidopoda.* India, Meghalaya, Khasi Hills, above Shillong, 24 November 1978, *C. R. Fraser-Jenkins* 8839 (H). Scale line = 1 cm.

Cytology: Diploid apomict (E. Himalaya: Gibby (1985). W. China: Gibby (1985)).

Ecology: A species of mid-level forests, growing on the ground, from *c.* 1300–3000 m alt.

Range: India (central and eastern parts of the W. Himalaya; E. Himalaya in Sikkim and Assam); Nepal; Bhutan; SE. Tibet; China (Yunnan, Szechuan); Taiwan. A Sino-Himalayan species of the widespread sort.

Range in the Indian subcontinent: **37** Panju, Samsog, Chhachpur, east of Simla, 9000 ft (2740 m), 22 September 1980, *C. R. Fraser-Jenkins* 10228, 10256, *S. P. Khullar & J. B. Oberoi* (BM!); **39** Mundali, Jaunsar, 8000 ft (2440 m), April 1895, *J. S. Gamble* 25398 (BM!, K!); **40** Nag Tibba Mt, Tehri Garhwal, 9500 ft (2890 m), 1879, *P. M. & V. A. Mackinnon* (BM!, DD!, RAW!); **42** Dhakara, Tehri Garhwal, 15 October 1879, *Herschel* (CAL!, DD!); **58** Phulchowki, Kathmandu, 4200 ft (1280 m), January 1954, *R. L. Fleming* 1599 (KATH!); **64** Tonglu Road, Darjeeling, 9500 ft (2890 m), 30 July 1957, *D. S. Loyal* 766 (PAN 1432!); **65** Sikkim, 1837, *T. Thomson* (BM!); **67** Phuntsholing (900 m) to Putli Bhir (2000 m) to Pasikha

(1800 m) to Thargyal Mathur Bridge (1500 m) to Ghima Khothi (2150 m), 4 April 1967, *H. Hara et al.* 2119 (TI!); **68** Ritang (2400 m) to Ratsoo (1850 m), 23 April 1967, *H. Kanai et al.* 25383 (BM!), 4211 (TI!); **77** Mishmee, *Mrs Mack* (K!); **79** Kohima, 6000 ft (1830 m), 21 October 1885, *C. B. Clarke* 40969 (K!); **83** 10 km above Shillong on road to the peak, Khasi Hills, 1800 m, 24 November 1978, *C. R. Fraser-Jenkins* 8826, 8833, 8834 (BM!), 8826, 8829, 8830, 8837–8839, 8841, 8842 (H!).

Notes: Readily distinguishable from *D. wallichiana* by its wider frond-base, longer stipe with all the scales narrow, and pinnules with rounded-truncate apices bearing marked small, acute teeth around the apex.

Dryopteris lepidopoda is somewhat variable, some specimens having the characteristic truncate pinnules and wide lamina bases, and others having more rounded-pointed pinnules and less wide lamina bases (with combinations of the two); the scales can sometimes be brown rather than the characteristic black. Thus some specimens approach *D. wallichiana* (some of my collections from Shillong Peak, nos 8832 (BM!), 8832, 8835, 8840 (H!), are intermediate and difficult to identify), but these are apparently not hybrids (impossible between apomicts) and have normal apomictic-type spores, so are presumed to represent variation within *D. lepidopoda*. In addition to morphological variation there is also some chemical variation (Widén et al., in prep.) which is mainly, but not entirely, quantitative. However, this variation does not seem to correspond with any particular morphology and there is little reason to suppose that a complex is involved.

14. Dryopteris wallichiana (Sprengel) N. Hylander **Fig. 16**

in *Bot. Notiser* 1953: 352 (1953). – *Aspidium wallichianum* Sprengel, *Syst. veg. ed. 16* **4** (1): 104 (1827), non C. Presl ex Kunze (1851). Type: Nepal, 1820, *Wallich* 340 (B! – lectotype, selected here; BM!, G!, K!, L!, P!, W! – isolectotypes (sometimes mixed with other species)).

Aspidium paleaceum Lagasca ex Sw., *Syn. fil.*: 52 (1806). – *Lastrea paleacea* (Lagasca ex Sw.) T. Moore, *Index fil.*: 99 (1858). – *Dryopteris paleacea* (Lagasca ex Sw.) C. Chr. in *Am. Fern J.* **1**: 94 (1911), nom. illeg. (Art. 64.1), non (T. Moore) Hand.-Mazz. (1908) (= '(T. Moore) Fomin' (1911)). – *Dryopteris filix-mas* subsp. *paleacea* (Lagasca ex Sw.) C. Chr. in Rosenv., *Biologiske arbejder tilegnede Eug. Warming*: 76 (1911). Type: Peru, *Lagasca*, Herb. Swartz (S! – holotype).

Aspidium paleaceum D. Don, *Prodr. fl. nepal.*: 4 (1825), nom. illeg. (Art. 64.1), non Lagasca ex Sw. (1806). – *Lastrea filix-mas* var. *paleacea* T. Moore, *Ferns Gr. Brit.*: pl. 17B, text (November 1855); *Pop. hist. Brit. ferns*, ed. 2: 86 (November 1855). – *Aspidium filix-mas* var. *paleaceum* (T. Moore) Mett. in *Abh. senckenb. naturforsch. Ges.* **2** (2): 339 (1858) (= *Farngatt.* **4**: 55 (1859)). – *Nephrodium filix-mas* var. *paleaceum* (T. Moore) Hook., *Fil. exot.*: pl. 98, text (1859). – *Aspidium filix-mas* forma *paleaceum* (T. Moore) Asch., *Syn. mitteleur. Fl.* **1**: 28 (May 1896). – *Nephrodium filix-mas* forma *paleaceum* (T. Moore) Fiori in Fiori & Paol., *Fl. Italia* **1**: 8 (December 1896). – *Aspidium paleaceum* (T. Moore) Dalla Torre & Sarnth., *Fl. Tirol* **6** (1): 46 (1906), nom. illeg. (Art. 64.1), non Lagasca ex Sw. (1806). – *Dryopteris filix-mas* var. *paleacea* (T. Moore) Druce, *List Brit. pl.*: 87 (January 1908). – *Dryopteris paleacea* (T. Moore) Hand.-Mazz. in *Verh. zool.-bot. Ges. Wien* **58**: (100) (June 1908). – *Polystichum filix-mas* var. *paleaceum* (T. Moore) Fiori, *Nuov. Fl. Italia* **1**: 23 (1923). – *Nephrodium filix-mas* subsp. *paleaceum* (T. Moore) Brause & Andres (1926), fide R. Soó, *A magyar flóra.* **1**: 545 (1964). – *Dryopteris filix-mas* subsp. *paleacea* (T. Moore) W. Koch ex Braun-Blanquet & Ruebel in *Veröff. geobot. Inst. Zürich* **7**: 34 (1932). Type: Nepal, *Wallich* [340], annotated by Don (BM! – lectotype, selected here; BM!, K!, K-W! – isolectotypes).

Aspidium donianum Sprengel, *Syst. veg. ed. 16* **4** (2): 320 (1827), nom. illeg. (Art. 63.1). – *Dryopteris doniana* (Sprengel) Ching in *Sunyatsenia* **6**: 3 (1941), nom. illeg. (Art. 63.1). Type: as for *Aspidium wallichianum* Sprengel.

Aspidium patentissimum Wallich, *Num. List*: no. 340 (1828), nom. nud. (Art. 32.1). – *Lastrea patentissima* C. Presl, *Tent. pterid.*: 76 (1836), nom. nud. (Art. 32.1). – *Aspidium patentissimum* Wallich ex Kunze in *Linnaea* **13**: 146 (1839), nom. illeg. (Art. 63.1). – *Lastrea patentissima* (Wallich ex Kunze) J. Smith in *J. Bot.* **4**: 193 (1842); Beddome, *Ferns S. India*: 39, pl. 111 (1864), nom. illeg. (Art. 63.1). – *Dichasium patentissimum* (Wallich ex Kunze) Fée, *Mém. foug.* **5**: 303, pl. 23B, fig. 2 (1852), nom. illeg. (Art. 63.1). – *Nephrodium patentissimum* (Wallich ex Kunze) C. B. Clarke in *J. Linn. Soc.* (Bot.) **15**: 156 (1876), nom. illeg. (Art. 63.1). – *Lastrea filix-mas* var. *patentissima* (Wallich ex Kunze) Beddome, *Suppl. ferns S. Ind.*: 29 (1876), nom. illeg. (Art. 63.1). – *Nephrodium filix-mas* var. *patentissimum* (Wallich ex Kunze) C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 520 (1880), nom. illeg. (Art. 63.1). – *Nephrodium parallelogrammum* forma *patentissimum* (Wallich ex Kunze) C. Hope in *J. Bombay nat.*

Hist. Soc. **14**: 728 (1903), nom. illeg. (Art. 63.1). – *Dryopteris filix-mas* subsp. *patentissimum* (Wallich ex Kunze) C. Chr., *Index filic.*: 265 (1905), nom. illeg. (Art. 63.1). – *Dryopteris patentissima* (Wallich ex Kunze) Nair in *Indian Forester* **94**: 169 (1968), nom. illeg. (Art. 63.1). Type: as for *Aspidium wallichianum* Sprengel.

Aspidium parallelogrammum Kunze in *Linnaea* **13**: 146 (1839). – *Lastrea parallelogramma* (Kunze) Liebm. in *K. dansk. Vidensk. Selsk. Skr.* V, **1**: 271 (1849). – *Dichasium parallelogrammum* (Kunze) Fée, *Mém. foug.* **5**: 303, pl. 23B, fig. 1 (1852). – *Lastrea filix-mas* var. *parallelogramma* (Kunze) Beddome, *Handb. ferns Brit. India*: 249 (1883). – *Aspidium filix-mas* var. *parallelogrammum* (Kunze) Hillebrand, *Fl. Hawaiian Isl.*: 574 (1888). – *Nephrodium parallelogrammum* (Kunze) C. Hope in *J. Bombay nat. Hist. Soc.* **14**: 728 (1903). – *Dryopteris filix-mas* var. *parallelogramma* (Kunze) Christ in *Philipp. J. Sci.* C (Bot.) **2**: 212 (1907). – *Dryopteris filix-mas* subsp. *parallelogramma* (Kunze) Christ in *Annu. Conserv. Jard. bot. Genève* **15–16**: 187 (1912). – *Dryopteris parallelogramma* (Kunze) Alston in *Am. Fern J.* **47**: 91 (1957). Type: Mexico, *Hegewisch & de Karwinski*, Herb. Lucae (KIEL – holotype).

Aspidium crinitum M. Martens & Galeotti in *Nouv. Mém. Acad. r. Sci. Bruxelles* **15**: 66, pl. 17, fig. 2 (1842), non Wallich (1828), nom. nud. – *Dryopteris filix-mas* var. *crinita* (M. Martens & Galeotti) Rosenstock, teste Rothm. (1943). Type: Mexico, prov. de Oaxaca, Llano verde, 4000–6000 ft, October 1834, *H. G. Galeotti* 6348 (BR! – lectotype, selected here; B!, BR!, K! – isolectotypes).

Dryopteris cyrtolepis Hayata, *Icon. pl. formos.* **4**: 149, fig. 89 (1914). – *Dryopteris cyrtolepis* var. *typica* H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 11 (1939 ['1938']), nom. inval. (Art. 24.3). Type: Taiwan, Mt Arisan, January 1912, *B. Hayata & S. Sasaki* (TI! – holotype).

Dryopteris pachyphylla Hayata, *Icon. pl. formos.* **4**: 168, fig. 108 (1914), nom. illeg. (Art. 64.1), non (Kunze) Kuntze (1891). Type: Taiwan, Arisan, 7000 ft, January 1912, *B. Hayata & S. Sasaki* (TI, (IBSC, photograph!) – holotype).

Dryopteris ursipes Hayata, *Icon. pl. formos.* **5**: 291, fig. 116 (1915). Type: Taiwan, Mt Morrison, 7000 ft, October 1906, *U. Mori* 1881 (TI, (IBSC, photograph!) – holotype).

Dryopteris mediterranea (and forma *mediterranea*) Fomin in V. Komarov, *Fl. URSS* **1**: 35 (1934), nom. nov. for *Lastrea filix-mas* var. *paleacea* T. Moore.

Dryopteris doiana Tag. in *Acta phytotax. geobot. Kyoto* **5**: 253 (1936). – *Dryopteris cyrtolepis* var. *doiana* (Tag.) H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 11 (1939 ['1938']). Type: Japan, Yuno, Isl. Sakura-zima, prov. Satuma, 24 July 1935, *Z. Kawamura* 12 (KYO! – holotype).

Dryopteris quatanensis Ching in *Wuyi Sci. J.* **1**: 6 (1981). Type: China, Fukien (Fujian), Chong-an Xian, Quatan, Wuyi-shan, 25 August 1979, *Wuyi Expedition* 915 (PE! – holotype).

Dryopteris wallichiana var. *himalaica* Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 257 (1983). Type: Tibet, Cha Yü, Hsieh Cha Yü, 2300 m, 14 July 1973, *Chinghai-Xizang Expedition* 73–682 (PE!) – holotype).

Fronds large (up to *c.* 140 cm long), forming a shuttlecock, though often slightly drooping. Stipe short to medium in length, up to *c.* ¼ the length of the lamina, thick, stipe-base very densely clothed with large, lanceolate and narrowly lanceolate scales, which remain markedly dense but usually become very narrow further up, particularly on the rachis, where they are usually markedly long with fine, attenuate apices, though some specimens may have slightly wider (or narrower) and more scattered scales; scales varying considerably in colour (sometimes in one population, or even somewhat in one plant from year to year) from very dark, or black, to mid-brown, russet-brown, or occasionally pale, but usually with a darker, or ± black base. Lamina becoming twice pinnate below, ± narrowly lanceolate (up to *c.* 35 cm wide), varying from only very slightly tapered to a truncate base to considerably tapered to a narrowly truncate base, bearing many (up to *c.* 45 pairs) ± contiguous, narrow, regular pinnae; pinnae linear, noticeably coriaceous, the upper surface glossy and mid- to dark green (markedly yellow-green when young), bearing small, scattered, very narrow, pale- to mid-brown scales on the costae and a very few small, scattered, very narrowly hair-like, pale brown fibrils on the costules, which almost all drop off as the frond becomes mature, pinnae bearing numerous (up to *c.* 25 pairs) highly regular, small to medium-sized, rectangular lobes, or pinnules, which do not become developed on the basiscopic side of the lower pinnae; pinna-lobes noticeably larger than in *D. pulcherrima* or *D. redactopinnata*, joined only at their bases and becoming separated into pinnules at the very bases of the lower-middle pinnae, markedly parallel-sided and unlobed, apart from a basal auricle on the basiscopic side of the basal pair of pinnules on each pinna and occasional shallow side-lobes, mainly in the mid-upper pinnae, pinnule apices varying from

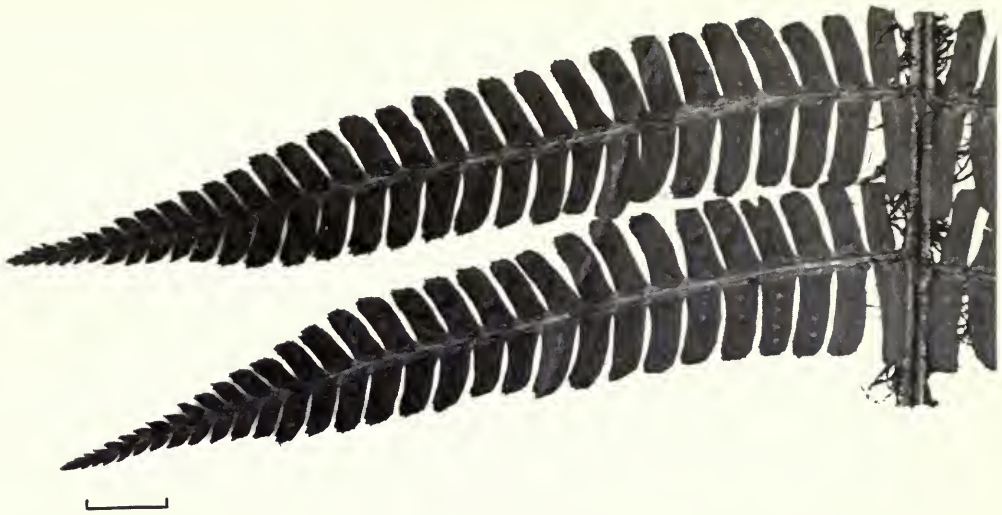

Fig. 16 *Dryopteris wallichiana.* India, West Bengal, Darjeeling, Tonglo, Kalpokhri to Gairibas, 15 November 1978, *C. R. Fraser-Jenkins* 8487 (BM). Scale line = 1 cm.

markedly squarely truncate to truncate with rounded corners, seldom becoming more rounded, bearing somewhat insignificant, triangular-lanceolate, acute teeth, though these are frequently absent from the centre of the apex. Sori in two rows, one on either side of the centre of the pinna-lobe, indusiate; indusia thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores somewhat irregular, with fully formed and a minority of abortive spores.

Cytology: Diploid apomict (E. Himalaya: Loyal (1960). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal* 712 and 30 July 1957 (PAN 1322!, 2108!, 2109!, 2228!). Gibby (1985). Japan: Schneller (pers. comm. and in prep.), voucher specimen, *K. Iwatsuki*, 1976, ex hort. T. Reichstein (4166), *C. R. Fraser-Jenkins* 9824 (BM!). Taiwan: Hirabayashi (1970, 1974). Gibby (1985). Borneo: Gibby (1985). Costa Rica: Gibby (1985). Peru: Gibby (1985)). Mickel, Wagner & Chen (1966) report a triploid from Mexico (as *D. parallelogramma*) but the voucher specimen (*J. T. Mickel* 658 (MICH!)) is *D. pseudo-filix-mas.* Reports of triploids from S. India and Sri Lanka refer to *D. madrasensis*, from Zimbabwe to the related *D. reichsteinii* Fraser-Jenkins, and from Nepal (Roy, Sinha & Sakya, 1971) to *D. juxtaposita* (voucher specimen, *A. R. Sakya* (Herb. Univ. Patna!)). The report of a tetraploid from Jamaica by Walker (1973) requires further investigation as it seems more likely that a diploid apomict could have been involved, especially as the number of sixteen-celled sporangia in this species can sometimes be very low. His specimen (T.5505 (Herb. T. Walker!)) is typical *D. wallichiana* and matches the Himalayan material exactly.

Ecology: A species of the mid- and upper-level forest zone, growing on the ground, usually below trees, from *c.* 1900–3500 m alt.

Range: India (central and eastern parts of the W. Himalaya; E. Himalaya in Sikkim and N. Assam; Assam); Nepal; Bhutan; S. and SE. Tibet; S. China (Yunnan, Szechuan, Shensi (Tai Pei Shan, *Wang, T.-P.* 8788, PE!), Kweichow, Fukien); Taiwan; N. and W. Burma; N. Vietnam; S. Japan (rare); Philippines; Sulawesi; Borneo; Java; New Guinea; Hawaii; Mexico; Cuba; Jamaica; Haiti; Dominica; Guatemala; Costa Rica; Panama; Colombia; Venezuela; Brazil; Ecuador; Peru; Bolivia; Argentina; Gough Island. Reports from the further W. Himalaya refer to *D. redactopinnata*, from S. India and Sri Lanka to *D. madrasensis*, and from New Guinea to both *D. wallichiana* and a more common new species, *D. parrisiae* Fraser-Jenkins. Reports from Zimbabwe and Madagascar refer to *D. reichsteinii*.

D. wallichiana is a pan-subtropical or tropical-montane species, with its centre of distribution in SW. China and the east Himalaya, where the greatest wealth of variants exists today. In the Indian subcontinent it has the distribution of a widespread Sino-Himalayan species.

Range in the Indian subcontinent: **32** Gharosan Forest, Chamba, 6500 ft (1980 m), 8 June 1895, *J. H. Lace* 747 (CAL!, E!) and Bara valley, 6000 ft (1830 m), 1898, *J. Marten* 40 (E!); **37** Panju, Chhachpur, east of Simla, 9000 ft (2740 m), 22 September 1980, *C. R. Fraser-Jenkins* 10225, *S. P. Khullar & J. B. S. Oberoi* (BM!); **39** Deoban, Jaunsar, 8500 ft (2590 m), 1936, *C. E. Parkinson* (DD!); **40**, Mussoorie, 1873 (DD!); **41** Tehri Garhwal, below Banga Pani, near Kedarkanta, 10,000 ft (3040 m), *J. F. Duthie* 1298 (DD!); **42** 1½ km below Trijugi Naryan on path to Mongu, north of Rudraprayag, 1900 m, 24 October 1978, *C. R. Fraser-Jenkins* 8283 (BM!); **43** Hanuman Chatti, south of Badrinath, north-east of Rishikesh, 2600 m, 17 September 1977, *C. R. Fraser-Jenkins* 7259 (BM!); **45** Pindar Gorge, near Dwali, 8000–8500 ft (2440–2590 m), 10 September 1891, *E. W. Trotter* 841 (RAW!); **48** Forest above Gini, 8000 ft (2400 m), 17 August 1884, *J. F. Duthie* 3670 (BM!); **51** Gurjakhani, 8500 ft (2590 m), 28 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams 3672 (BM!, E!);* **53** Gaja Lekh, Baglung, 2600 m, 3 December 1973, *D. P. Joshi & M. M. Amatya* 0314 (KATH!); **54** 5 km above Tukche, 11,500 ft (3490 m), 1 December 1949, *R. L. Fleming* 889 (BM!, DD!, K!); **55** Panchabe Lekh, Kaski District, 2320 m, 13 December 1973, *D. P. Joshi & M. M. Amatya* 0435 (KATH!); **57** Near Ghonga Bhanjyang, 2800 m, 19 May 1973, *P. R. Shakya & T. K. Bhattacharya* 2199 (KATH!); **58** Bagdwar, Sheopuri, 2570 m, 21 March 1975, *D. P. Joshi & K. R. Rajbhandari* 75/780 (KATH!); **59** Lama Lodge to Ghoda Tabela, Rasuwa, Langtang, 2700–3100 m, 3 October 1977, *V. L. Gurung & party* 77/716 (KATH!); **60** Rimoo, 9–10,000 ft (2740–3040 m), 21 February 1931, *Capt. Lall Dhwoj* 0444 (BM!, E!); **62** Topke Gola (3600 m) to Shewaden (2600 m), 28 June 1972, *H. Kanai et al.* 725311 (KATH!); **63** Mai Pokhari, Ilam, 7500 ft (2290 m), 17 September 1978, *R. L. Fleming* 2497 (BM!, KATH!); **64** Gairibas to Tonglo, Singalilla ridge, west of Darjeeling, 2700 m, 15 November 1978, *C. R. Fraser-Jenkins* 8535, 8537 (BM!), 8536, 8538 (H!); **65** Yoksam to Bakkim, 1200–2200 m, 18 May 1960, *H. Hara et al.* 409 (2359) (E!, K!); **67** Thimphu (2250 m) to Sintoka Dzong to Dochula (3050 m) to Yuwak (1400 m) to Wangdu Phodrang (1250 m), 9 April 1967, *H. Hara et al.* 4207 (BM!, TI!); **68** Gasa (2600 m) to Pari La (3550 m) to Chamsa (3500 m), 14 May 1967, *H. Kanai et al.* 12704 (BM!, TI!); **71** Rocha Chu Valley, Trashiyangsi, 8000 ft (2440 m), 25 September 1934, *F. Ludlow & G. Sherriff* 983 (BM!); **74** Rho Basti, Tawang, *P. Chandra* 80412 (LWG!) and Kameng (CAL!); **75** Subansiri Frontier Division, Ziro, 30 September 1959, *G. Panigrahi* 19872 (DD!); **80** Peak north-east of Ching Tow, 8000 ft (2440 m), April 1882, *G. Watt* 6592 (CAL!, P!); **83** 5 km east of Mairang, west of Shillong, 1800 m, 26 November 1978, *C. R. Fraser-Jenkins* 8879 (BM!).

Notes: Wallich's specimens of *Aspidium patentissimum* were mainly the present species but he did not validly publish the name. This was done by Kunze (1839), who referred to Wallich's plant. Subsequent descriptions of the Wallichian plant were provided by Clarke (1876, 1880), who pointed out that the sense in which Beddome (1864) took the name in his description was mainly of the south Indian plant now known as *Dryopteris madrasensis*, though by referring to Wallich, Beddome was merely making a new combination based on Kunze's name.

Franchet (1887) also used the name *Aspidium patentissimum* and provided a further description. Nair (1968) has made the combination *Dryopteris patentissima*, referring to Franchet though following Christensen (1905) in applying the name, erroneously, to *D. lepidopoda*. However, Franchet's specimen (P!) is not *D. lepidopoda*, but *D. wallichiana* and is in any case not relevant as both his description and his citations refer directly to the Wallichian plant, already described by Kunze. The correct citation for this combination in *Dryopteris* is therefore *D. patentissima* (Wallich ex Kunze) Nair, which passes into the synonymy of *D. wallichiana*. This is in contrast to the view of Panigrahi & Basu (1980), who follow Christensen (1905), and thus Nair (1968), and repeat Nair's combination. They also erroneously cite as the type a Clarke specimen of *Nephrodium filix-mas* var. *khasiana*, which is *D. lepidopoda* and not relevant to the name *D. patentissima*.

The nomenclature of *D. wallichiana* and the reason why it is the correct name are also involved (see Alston, 1957; Fraser-Jenkins, 1980*b*; Smith & Fraser-Jenkins, 1982). Alston maintained that Don's *Aspidium paleaceum* was independent nomenclaturally and taxonomically from Swartz's, a view that was contradicted by Rothmaler (1943), who used the name *Dryopteris paleacea* with the authorities given as (Sw.) Hand.-Mazz., to apply to the American and Himalayan plants and also to the distinct European species, *D. affinis* (Lowe) Fraser-

Jenkins, which he included within his concept. Fraser-Jenkins (1980*b*) pointed out that the American and Asiatic plants belong to the same species, a view put forward by Christensen (1931) and supported more recently by Price (1977), but erroneously concluded that Don's name was taken from Swartz, thus agreeing in more detail with Rothmaler. Since then Smith & Fraser-Jenkins (1982) have shown in detail that Don's nomenclature was independent of Swartz's (or of other authors') in the cases when he did not directly cite an authority for the name, as in the present case. Thus Alston's somewhat briefly stated nomenclatural conclusion stands, though not his taxonomic one. Therefore the combination, *Dryopteris paleacea* (Lagasca ex Sw.) C. Chr., of 1911, cannot be used because it is predated by the independent *D. paleacea* (T. Moore) Hand.-Mazz., of 1908. Hence *D. wallichiana* is the correct name for the present species.

A further complication concerning Don's epithet *paleaceum* is that Moore was the first author after Don to use it, but in 1853 he did so without referring to Don and partly in a different sense, though it was invalid (sub *Lastrea filix-mas* var. *paleacea*) as he indicated doubt and did not accept it as any more than 'perhaps entitled to the rank of variety'. Neither then nor in his *A popular history of the British ferns* (Moore, 1855*b*) did he mention its range outside of Britain, nor give any authority for the variety. This is only to be expected as it would have been outside of the scope and format of the two somewhat condensed works, and he did not normally give the authorities for varieties (as for example with *Lastrea filix-mas* var. *abbreviata* on the same page (Moore, 1855*b*)), nor the extra-British range of taxa. This has unfortunately led some later authors to treat Moore's variety as taxonomically and nomenclaturally independent of Don's *paleaceum* and as applying to the European plant only. However Moore (1855*a*) gives the full details of all the species and varieties including their synonymy and worldwide range, and is a far more detailed work. As it was published simultaneously with the relevant pages in Moore (1855*b*) it, rather than the condensed work, must be taken as containing the protologue of the variety. It also shows that even in the condensed work he took the name from Don, whom he cites by way of attribution in the fuller work. Moore also stated (1855*a*) that his concept embraced the British and worldwide plants as one and the same variety, an idea which he continued to follow in all his later works, when the format allowed it, and which he later expanded to include Swartz's *Aspidium paleaceum*. Though he pointed out (1855*a*) that the plants of this variety from the Himalaya differed slightly from the European ones, his type has to be taken as the same as Don's because of his citation of Don, regardless of in which sense (presumably subvarietally) he was taking the name at any particular time. As Don's name was illegitimate, Moore's name stands as nomenclaturally (but not taxonomically) independent of it, but is still a synonym of *D. wallichiana*, as are the combinations of later authors based on Moore or Don (but not if they cite Swartz as well), even if they were only referring to the European plant. As a result Fomin's *D. mediterranea*, as a nomen novum for Moore's variety, also has to be based on the same type and transferred to the synonymy of *D. wallichiana*, against the sense in which Fomin took it.

Dryopteris wallichiana, as construed here, is a diploid apomict. Several related taxa (*D. redactopinnata, D. neorosthornii, D. madrasensis, D. reichsteinii* and *D. parrisiae*) have been separated from it, which clarifies the complex considerably. The diploid appears to constitute a single species rather than an aggregate, though it contains a considerable range of variation (even in the Himalaya alone) in terms of pinnule-size and scale colour, width and density. The variants themselves appear to be more or less continuous though some of the extremes appear somewhat distinct, but they are of little taxonomic significance. One apparently distinct variant from the Darjeeling area and east Nepal, with slightly larger pinnules with impressed veins, and scattered, somewhat wide, dark scales, has been subjected to a preliminary chemical investigation by Widén et al. (in prep.) and found to contain approximately the same phloroglucides as normal *D. wallichiana* (though the results for several species close to *D. wallichiana* may be too similar to be diagnostic). It is also the same cytologically (1985), voucher specimen, *C. R. Fraser-Jenkins* 10364 (BM!)) and further investigation shows there to be a complete range of fertile intermediates between it and normal *D. wallichiana*. Both this and other such forms in the area are envisaged as being no more than variation within the species, which is probably

somewhat marked due to its apomictic nature (see also under *D. pulcherrima* and *D. dickinsii*).

There also exists another species in the complex in Mexico, which is a triploid apomict, the more distinctly different *D. pseudo-filix-mas* (Fée) Rothm. (synonym: *D. chrysocarpa* (Fée) Rothm.), with more pointed pinnules.

In the west Himalaya, *D. wallichiana* is replaced by the diploid species, *D. redactopinnata*, which has not previously been clearly separated and is intermediate between it and *D. pulcherrima*. At higher altitudes in the Himalaya, *D. wallichiana* is replaced by the diploid apomict, *D. pulcherrima* and the somewhat uncommon triploid, *D. neorosthornii*.

In south India and Sri Lanka, *D. wallichiana* is replaced by the triploid apomict, *D. madrasensis* (see under that species), in Zimbabwe and Madagascar by the triploid apomict, *D. reichsteinii* (= *D. paleacea* var. *madagascariensis* C. Chr.), and in New Guinea mainly by a further distinct triploid species, *D. parrisiae* Fraser-Jenkins, which is a smaller plant with paler scales, a more crispaceous lamina, and the pinna-lobes more widely fused together. Somewhat confusingly the populations of *D. wallichiana* in Java, Borneo, and New Guinea approach *D. parrisiae* in morphology, though they are not as extreme as that species, and in view of the diploid count obtained by Gibby (1985) on such plants from Borneo and their not being clearly distinct from *D. wallichiana*, they are not recognised here as a separate taxon. *D. parrisiae* has often been confused in herbaria with *Dryopsis adnata* (Blume) Holttum & Edwardes (synonyms: *Dryopteris adnata* (Blume) Alderw., *Ctenitis adnata* (Blume) Ching), a south-east Asian species somewhat similar to *Dryopsis clarkei* (Baker) Holttum & Edwardes of the Himalaya (itself often confused with *D. wallichiana*).

In Hawaii, as well as *D. wallichiana*, there is another related species, *D. fusco-atra* (Hillebrand) W. Robinson (synonym: *Lastrea truncata* Brackenr., non *Dryopteris truncata* (Poiret) Kuntze), similar to *D. madrasensis*, but more extreme in morphology when compared with *D. wallichiana*.

D. wallichiana is of considerable interest in having a worldwide tropical and subtropical distribution, which is uncommon in *Dryopteris*, though a worldwide north temperate distribution pattern occurs in some species, such as *D. filix-mas* (L.) Schott, *D. fragrans* (L.) Schott, and *D. expansa* (C. Presl) Fraser-Jenkins & Jermy.

Careful comparison of the Peruvian and Asiatic plants shows them to be virtually identical, and the cytological result of Gibby (Fraser-Jenkins, 1980*a*) showing the Peruvian plant to be diploid is therefore of considerable significance. On the basis of its morphology, and assuming that a cytological result showing full pairing in the sixteen-celled sporangia at meiosis is correct (Loyal, 1960), it seems highly likely that *D. wallichiana* contains the same genome as that which must have given rise by hybridisation to the European *D. affinis* complex (see Fraser-Jenkins, 1980*a* and in prep.), but much work is required to examine this question further. In any case the present apomictic diploid could not have been the direct ancestor, as a sexual diploid form would have been needed, and this has not so far been discovered.

15. Dryopteris madrasensis Fraser-Jenkins, **sp. nov.** **Fig. 17**

Planta *D. wallichianae* similis, sed pinnis inferioribus longioribus saepe parum basiscopice evolutis, pinnulis longioribus apice obtusis, pinnulis superioribus aliquantum late conjunctis, differt. Cytotypus triploideus, apomictus. Type: S. India, Tamil Nadu, Western Ghats, Palni Hills, south-east of Kodaikanal, thick forest below Pillar Rocks by stream, *c.* 1200 m, 20 December 1978, *C. R. Fraser-Jenkins* 9208 (BM! – holotype; FR!, G! – isotypes).

Misapplied names: Lastrea patentissima sensu Beddome (1864), pro parte; *Dryopteris wallichiana* auct. (S. India and Sri Lanka).

Fronds large (up to *c.* 125 cm long), forming a spreading shuttlecock. Stipe of medium length or somewhat long, up to *c.* ⅓ the length of the lamina, stipe-base very densely clothed with large, ovate-lanceolate and narrowly lanceolate scales, remaining markedly dense, but all becoming very narrow further up and on the rachis, where they are markedly long with fine, attenuate apices, scales varying from very dark or black, to mid-brown, russet-brown, or occasionally pale (but usually with a dark or blackish base). Lamina becoming twice pinnate below, lanceolate to

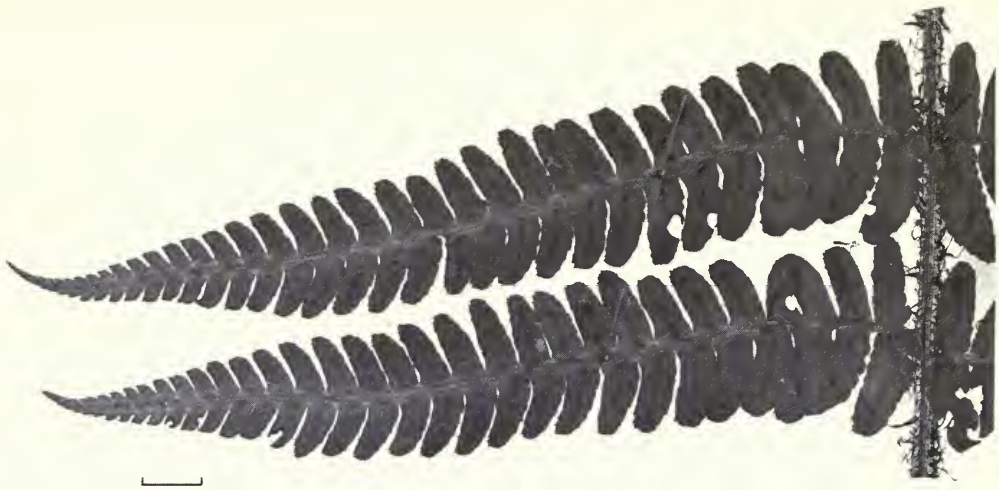

Fig. 17 *Dryopteris madrasensis*. India, Tamil Nadu, Palni Hills, Kodaikanal, Pillar Rocks, 20 December 1978, *C. R. Fraser-Jenkins* 9208 (BM – holotype). Scale line = 1 cm.

narrowly triangular-lanceolate (up to *c.* 30 cm wide), slightly tapered to a truncate or ± widely-truncate base, bearing many (up to *c.* 35 pairs) ± contiguous, narrow, regular pinnae; pinnae ± linear, noticeably coriaceous, the upper surface glossy and mid- to dark green (markedly yellow-green when young), bearing a few small, scattered, very narrow, hair-like, pale brown fibrillae, mostly on the costae and costules and almost all dropping off as the frond becomes mature, pinnae bearing numerous (up to *c.* 22 pairs) regular, small to medium-sized, crowded, rectangular lobes or pinnules, which often become slightly developed on their basiscopic side and noticeably longer than broad in the lowest few pinnae; pinnules similar in size to *D. wallichiana* or slightly longer, joined at their bases by a slightly wider wing of tissue than in *D. wallichiana*, but becoming fully separated at the very bases of the lower and lower-middle pinnae, those at the bases of the lowest pinnae becoming only narrowly attached to the costa, markedly parallel-sided and ± unlobed apart from a basal auricle on the basiscopic side of the basal pair of lobes on each pinna and occasional shallow side-lobes mainly in the mid-upper pinnae, pinnule apices rounded-truncate, usually becoming slightly obtusely pointed, especially in the lower pinnae, bearing ± small, triangular-lanceolate, acute teeth. Sori in two rows, one on either side of the centre of the pinnule, indusiate; indusia thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores irregular, with fully formed and a minority of abortive spores.

Cytology: Triploid apomict (Sri Lanka: Manton & Sledge (1954), voucher specimen, [leg. *W. A. Sledge*, 1951], ex hort. Leeds Univ. Bot. Garden, 19 October 1952, *A. H. G. Alston* 11833 (BM!), sub *D. paleacea*. S. India: Bhavanandan (1968, 1981), sub *D. wallichiana*. Gibby (1985)).

Ecology: A species of mid-level forests, growing on the ground, from *c.* 1200–2400 m alt.

Range: India (south); Sri Lanka. An endemic of Sino-Himalayan or south-east Asian affinity.

Range in the Indian subcontinent: **93** 4 km above Ootacamund, west side of Dodabetta Mt, Nilgiris, 2400 m, 26 December 1978, *C. R. Fraser-Jenkins* 9323, 9359 (BM!); **95** Below Pillar Rocks, south-east of Kodaikanal, Palni Hills, *c.* 1200 m, 20 December 1978, *C. R. Fraser-Jenkins* 9202, 9203 (BM!); **100** Jungle at Horton Plains, 7000 ft (2130 m), 20 December 1950, *W. A. Sledge* 677 (BM!).

Notes: Dryopteris madrasensis is presumably closely related to *D. wallichiana* and could well be derived from it by hybridisation. Preliminary studies of the phloroglucide content (Widén et al., in prep. and pers. comm. 1981) show similar results to *D. wallichiana*.

16. Dryopteris sledgei Fraser-Jenkins, **sp. nov.** **Fig. 18**

Stipes longus, basi excepto paleis nigris angustis aliquantum sparsis vestitus; pinnae separatae; pinnulae valde grandiorae quam illae *D. wallichianae*, apice rotundatae vel parum acutae. Cytotypus tetraploideus. Type: S. India, Tamil Nadu, Western Ghats, Nilgiri Hills, west side of Dodabetta Mt, 4 km above Ootacamund, stream in forest, 2450 m, 26 December 1978, *C. R. Fraser-Jenkins* 9355 (BM! – holotype; FR!, H! – isotypes). Other specimens from the type locality are located as follows: 9356, 9358 (BM!), 9348 (FR!), 9349 (G!), 9349–9354, 9356–9358 (H!), 9351, 9354 (PE!).

Fronds large (up to *c.* 130 cm long), spreading. Stipe long, *c.* ⅓ to ⅔ the length of the lamina, stipe-base densely clothed with long, lanceolate, black scales, becoming scattered, shorter and very narrow or almost fibrillose further up the stipe and on the rachis. Lamina becoming twice pinnate below, somewhat narrowly lanceolate (up to *c.* 30 cm wide), slightly tapered to a truncate base, bearing many (up to *c.* 30 pairs), somewhat distant, medium to narrow, regular pinnae; pinnae linear below but tapering towards their apices from about half their length, coriaceous, the upper surface slightly glossy and dark green, bearing a few small, scattered, very narrow, black scales on the underside of the costae, pinnae bearing numerous (up to *c.* 20 pairs) ± regular, medium-sized, rectangular lobes or pinnules, which usually become slightly basiscopically developed in the lowest few pinnae, noticeably longer than broad; pinnules noticeably larger than in *D. wallichiana*, joined at their bases by a somewhat wide wing of tissue, but fully separated from each other towards the bases of the mid and lower pinnae, stalked or only narrowly attached to the costa at the bases of the lowest pinnae, markedly parallel-sided and ± unlobed apart from a basal auricle on the basiscopic side of the basal pair of pinnules on each pinna, the lowest basiscopic pinnule on the lowest pinna often curving from just above its base so as to point slightly towards the pinna apex, pinnule-apices rounded or becoming obtusely pointed especially in the lower pinnae, bearing a few, scattered, long-acute teeth. Sori in two rows, one on either side of the centre of the pinnule, indusiate; indusia thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores irregular, with fully formed and a minority of abortive spores.

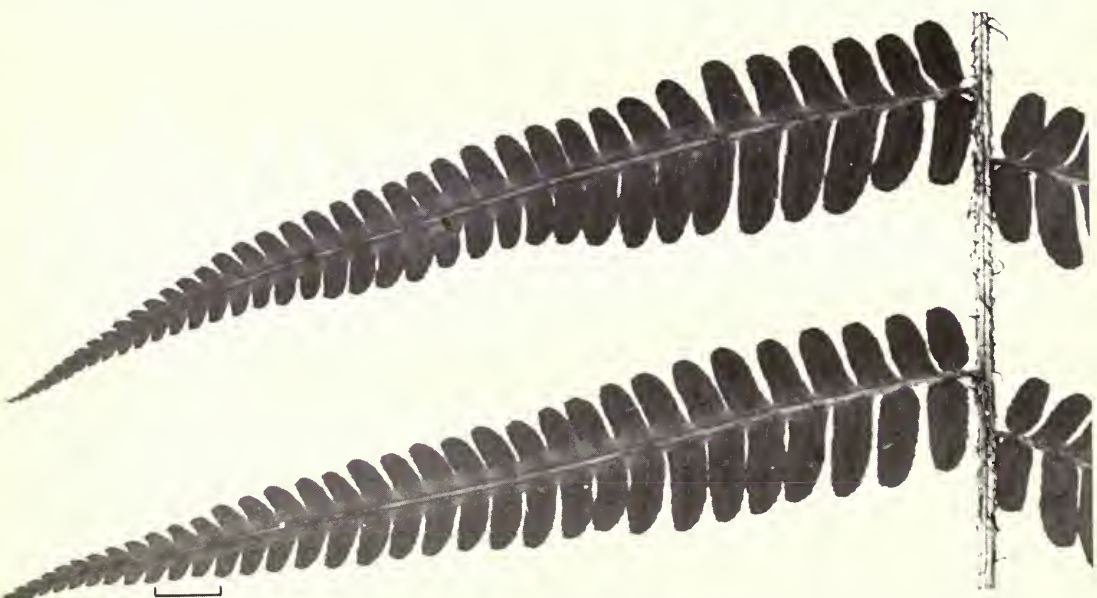

Fig. 18 *Dryopteris sledgei.* India, Tamil Nadu, Nilgiri Hills, Ootacamund, Dodabetta Mt, 26 December 1978, *C. R. Fraser-Jenkins* 9352 (H). Scale line = 1 cm.

Cytology: Tetraploid (S. India: Gibby (1985)). Probably apomictic.

Ecology: A species of mid- to upper-level forests, growing on the ground, usually near streams, from *c.* 2000–2200 m alt.

Range: India (south); Sri Lanka. An endemic species, possibly of south-east Asian affinity, though perhaps to be considered of Sino-Himalayan affinity.

Range in the Indian subcontinent: **93** 4 km above Ootacamund, Dodabetta Mt, Nilgiri Hills, 26 December 1978, *C. R. Fraser-Jenkins* 9355, 9356, 9358 (BM!), 9348, 9355 (FR!), 9349 (G!), 9349–9358 (H!), 9351, 9354 (PE!); **100** 'Ceylon', 1857 and 1858, Herb. J. Smith (BM!).

Notes: Previously confused with *Dryopteris wallichiana* though it is readily distinguishable by its larger, less rectangular segments and markedly less scaly upper stipe and rachis.

This species is named after Dr W. A. Sledge of the University of Leeds, who has worked extensively on the ferns of Sri Lanka.

17. Dryopteris khullarii Fraser-Jenkins, **sp. nov.** **Fig. 19**

Stipes longus; lamina elongate triangulari-lanceolata; pinnae e basi decrescentes; pinnulae quam illae *D. wallichianae* longiorae, margine valde sed non profunde lobatae, illae pinnarum inferiarum apice aliquantum acutae. Cytotypus triploideus, apomictus. Type: N. India, Uttar Pradesh, Chamoli, Mandakini valley, north of Rudraprayag, west of Sonprayag, *c.* 6 km above Trijugi Naryan on path to Mongu, forest, *c.* 2900 m, 25 October 1978, *C. R. Fraser-Jenkins* 8353 (BM! – holotype; FR!, H! – isotypes). Other specimens from the type locality are located as follows: 8352, 8355 (BM!), 8354 (G!), 8350–8352, 8354 (H!), 8350 (PE!).

Fronds large (up to *c.* 140 cm long), spreading. Stipe medium to long, *c.* ⅓ to ½ the length of the lamina, stipe-base very densely clothed with large, ovate-lanceolate and narrowly lanceolate scales which remain dense but become smaller and narrow further up and on the rachis, where they are mixed with small, very narrow scales with attenuate apices, scales varying from mid- to dark brown, with dark bases, the widest ones having dark patches in their centres. Lamina twice pinnate, narrowly triangular-lanceolate (up to *c.* 30 cm wide), not, or only very slightly, tapered to a somewhat widely truncate base, bearing many (up to *c.* 35 pairs) contiguous to slightly overlapping pinnae; pinnae triangular-lanceolate, tapering from just above the base, coriaceous, the upper surface somewhat glossy and mid- to dark green (yellow-green when young), bearing a few scattered, small, very narrow or hair-like, mid-brown scales and fibrils,

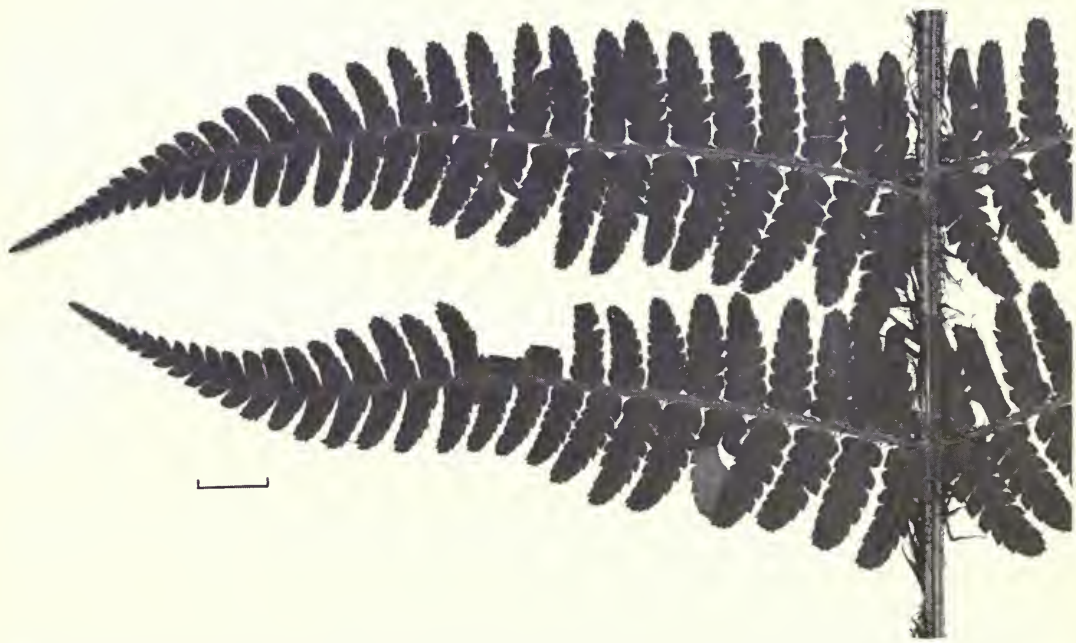

Fig. 19 *Dryopteris khullarii.* India, Uttar Pradesh, Chamoli, north of Rudraprayag, west of Sonprayag, Trijugi Naryan to Mongu, 25 October 1978, *C. R. Fraser-Jenkins* 8352 (BM). Scale line = 1 cm.

mostly on the costae and costules on the lower surface, and bearing numerous (up to *c.* 18 pairs) medium to large pinnules which are ± rectangular in the upper parts of the lower pinnae but become long and pointed in the mid and lower parts of the lower pinnae and often near the bases of the upper pinnae; pinnules somewhat developed on the basiscopic side of the mid and lower pinnae, becoming narrowly joined at their bases about half-way up the pinnae, but becoming narrowly attached to the costa or stalked near the bases of the pinnae, parallel-sided, markedly ± shallowly lobed throughout their length, with rectangular lobes, but the upper lobes becoming pointed and terminating in a tooth, pinnule apices varying from rounded-truncate in the upper half of the pinna to obtusely or somewhat acutely pointed below, bearing short, somewhat wide-based, acute teeth. Sori in two rows, one on either side of the centre of the pinnule, indusiate; indusia thick, becoming brown, lifting and shrivelling slightly, but mostly persistent. Spores irregular, with fully formed and a minority of abortive spores.

Cytology: Triploid apomict (W. Himalaya: Gibby (1985)).

Ecology: A species of mid- to upper-level forests, growing on the ground, from *c.* 1900–2500 m alt.

Range: India (W. Himalaya). A Sino-Himalayan species of the west Himalayan sort.

Range in the Indian subcontinent: **32** Bara valley, Chamba, 6000 ft (1830 m), 1898, *J. Marten* 40 (E!, K!); **42** 2 km above Jangal Chatti, *c.* 12 km up path to Kedarnath Mt, north-east of Dehra Dun, 2450 m, 15 September 1977, *C. R. Fraser-Jenkins* 7226, 7228 (BM!), 7227 (FR!), 7227 (PE!), 7226, 7228 (Herb. T. Reichstein, Basel!).

Notes: Dryopteris khullarii is intermediate in morphology between *D. wallichiana* and *D. nigropaleacea* and appears likely to have been derived by hybridisation between these two species. Young specimens are less lobed and can be confused with *D. wallichiana* (as might be expected if such an origin is correct, as it would contain two genomes of *D. wallichiana* and one of *D. nigropaleacea*), but full-sized ones are markedly distinct.

The species is named after Dr S. P. Khullar of Panjab University, Chandigarh, India, who is working most actively on west Himalayan ferns.

Section 3. Pandae Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 191 (1986).

18. Dryopteris bonatiana (Brause) Fraser-Jenkins, **comb. nov.** **Fig. 20**

Polystichum bonatianum Brause in *Hedwigia* **54**: 200, pl. 4B (1913). Type: China, Yunnan, *Maire* 3018 (B – holotype); Yunnan, 'Haute brousse des rochers de Ma-Hong', 3000 m, November 1910, *E. E. Maire* 3018 (BM!, K!, P! – isotypes).

Dryopteris yui Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 417 (1938). Type: China, Szechuan, Le Po Hsien, *Yü, T. T.* 3750 (PE! – lectotype, selected here; IBSC! – isolectotype).

Misapplied name: Dryopteris panda sensu Ching (1938), pro parte, from China.

Fronds medium-sized (up to *c.* 80 cm long). Stipe medium to long, up to about the same length as the lamina, sparsely clothed near the base with thin, adpressed, ovate, pale scales, which become smaller, narrower and very scattered further up, upper stipe and rachis almost, or completely without scales. Lamina once pinnate, but becoming a second time ± deeply pinnatifid, lanceolate, or somewhat triangular-lanceolate (up to *c.* 30 cm wide), only very slightly tapered to a widely truncate base, bearing rather few (up to *c.* 17 pairs) ± distant pinnae; pinnae linear, fragile and easily broken, somewhat thinly herbaceous, pale- to mid-green above, glabrous, bearing numerous (up to *c.* 14 pairs) sometimes rather irregular, ± wide lobes, extending to about half the depth of the pinna on each side, or more in large plants; pinna-lobes square, occasionally with rounded corners, widely truncate at their apices, bearing a few somewhat long and wide-based, acute teeth, especially at the corners of the apices. Sori large or very large (2–2·5 mm diam.), in a pair, one on each side of the pinna-lobe midrib, situated at the base of each lobe near the pinna costa, or occasionally with two or more sori on each side in large plants, indusiate; indusia flat, thin, white, shrivelling and mostly deciduous. Spores regular.

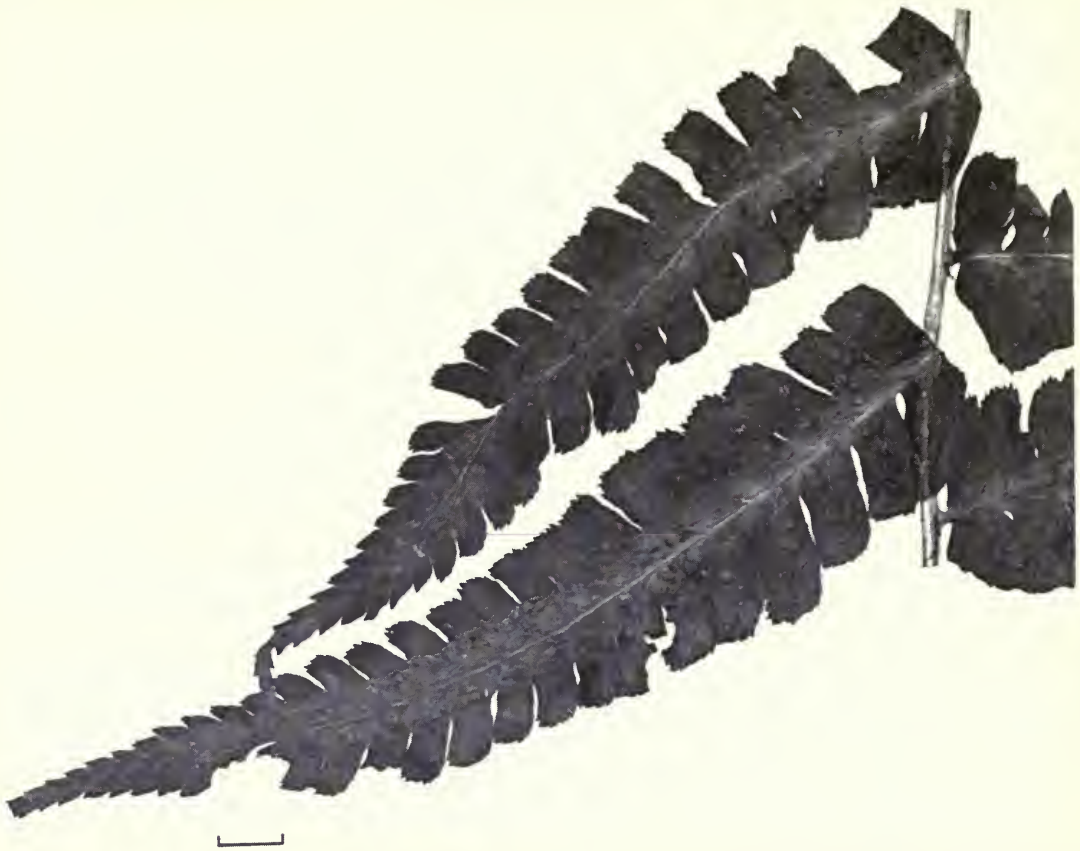

Fig. 20 *Dryopteris bonatiana*. E. Tibet and SW. China, Shweli to Salwin divide, October 1924, *George Forrest* 25264 (BM). Scale line = 1 cm.

Cytology: Tetraploid sexual (E. Himalaya: Mehra & Loyal (1965), sub *D. panda* (4x), voucher specimens, *D. S. Loyal* 43, 12 August 1956 (PAN 2323!, 2324!, 2325!)).

Ecology: A rare species of upper-level forests, growing on the ground, from *c.* 2900–3200 m alt.

Range: India (Himalaya in Sikkim); SE. Tibet; SW. China (Yunnan, Szechuan, Kweichow). A Sino-Himalayan species of the east Himalayan sort.

Range in the Indian subcontinent: **64** Kalpokhri, Darjeeling, 10,000 ft (3040 m), 12 August 1956, *D. S. Loyal* 43 (PAN 2323!, 2324!, 2325!); **65** Sikkim, October 1883, *H. C. Levinge* (CAL!).

Notes: Known from only two collections from the Sikkim region and reported here for the first time from the Indian subcontinent, *Dryopteris bonatiana* is very close to *D. panda* but has a wider and thinner lamina, fewer, larger, more basal sori, and wider, more square lobes, which distinguish it. Ching (1938) gave *Polystichum bonatianum* as a synonym of *D. panda*, but surprisingly did not mention the close affinity of *D. panda* to his new species *D. yui*. Further investigation is required into the cytology of *D. bonatiana* and *D. panda* as they can be very close in their morphology and the biological basis of the distinction between them is not fully understood.

The Taiwanese species, *D. costalisora* Tag., is closely related to *D. bonatiana*, but differs in its frequently slightly darker scales, smaller size, and less developed frond; it is also tetraploid (Tsai & Shieh, 1977).

19. Dryopteris panda (C. B. Clarke) Christ **Fig. 21**

in *Bull. Acad. int. Géogr. bot.* **19**: 175 (1909). – *Nephrodium filix-mas* var. *panda* C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 519, pl. 68, fig. 1 (1880). – *Lastrea filix-mas* var. *panda* (C. B. Clarke) Beddome, *Handb. ferns Brit. India*: 251 (1883). – *Nephrodium pandum* (C. B. Clarke) C. Hope in *J. Bombay nat. Hist. Soc.* **12**: 623 (1899). – *Dryopteris filix-mas* subsp. *panda* (C. B. Clarke) C. Chr., *Index filic.*: 265 (1905). Type: India, Dhurmsala, 10,000 ft, 18 October 1874, *C. B. Clarke* 24365K (K! – lectotype, selected here).

Fronds medium-sized to ± large (up to *c.* 110 cm long), arising singly or in groups of two to three from the apices of a branching rhizome which creeps closely along the surface of the ground and thus gives rise to a loose clump of fronds. Stipe long, up to *c.* the same length as the lamina, sparsely clothed near the base with thin, ± adpressed, ovate, pale scales, which become smaller, narrower and very scattered further up; upper stipe and rachis almost or completely without scales. Lamina once pinnate, but becoming a second time ± shallowly pinnatifid, ± narrowly lanceolate (up to *c.* 25 cm wide), usually slightly tapered below, but ending at a truncate base, bearing many (up to *c.* 20 pairs) ± distant pinnae; pinnae linear, fragile, rather thickly herbaceous, pale- to mid-green and matt above, glabrous, veins somewhat prominent, bearing numerous (up to *c.* 15 pairs) lobes extending to about half the depth of the pinna on each side, or occasionally deeper near the bases of the lower pinnae; pinna-lobes ± rounded, often with a slightly narrower rounded-truncate or truncate apex, but not usually completely rectangular, bearing several, somewhat irregular, narrowly acute teeth, especially on the truncate part of the apex. Sori medium-sized or somewhat large (1·5–2 mm diam.), ± in two short rows, one on either side of the centre of each lobe, half-way between the centre and the margins; sometimes extending to the pinna-costa, though often only one or a few are present on each side of the lobe, indusiate; indusia flat, thin, white, shrivelling and ± deciduous. Spores reddish-brown, the perispore often somewhat pointed at each end of the spore, ± regular.

Cytology: Diploid sexual (E. Himalaya: Mehra & Loyal (1965), voucher specimen, *D. S. Loyal*, July 1958 (PAN 2509!, 2510!, 2511!)).

Ecology: A somewhat uncommon species of light, upper-level forests, growing on the ground, often on slopes below bushes, from *c.* 2300–3500 m alt.

Range: India (central and eastern parts of the W. Himalaya; E. Himalaya in Sikkim); Nepal; SE. Tibet; China (Yunnan, Szechuan). Reported from N. China, Mongolia and Korea by Tagawa (1941) and from Korea by Nakai (1952), in error for *D. woodsiisora*. A Sino-Himalayan species of the widespread sort, though confined to the main Himalayan ranges in the eastern parts of its range.

Range in the Indian subcontinent: **32** Chamba, Shaol Forest, 1898, *J. Marten* 29 (E!, K!); **33** Nr Triund, Dharmsala, 2700 m, 25 October 1972, *Puran Singh* 63 (PAN 6850!); **35** 10 km above Manali, south side of Rohtang Pass, north of Mandi, north of Simla, 2400 m, 2 September 1977, *C. R. Fraser-Jenkins* 6775, 6780 (BM!), 6778, 6781 (PE!), 6779 (Herb. T. Reichstein, Basel!); **37** Jaku, Simla (CAL!) and Sirmaor, *Vicary* 1831 (CAL!); **41** Above Jalla, Ganges valley, Tehri Garhwal, 11–12,000 ft (3340–3640 m), 10 October 1881, *J. F. Duthie* 2223 (BM!, DD!); **42** Top of ridge between Trijugi Naryan and Mongu, west of Sonprayag, Mandakini valley, north of Rudraprayag, 3300 m, 25 October 1978, *C. R. Fraser-Jenkins* 8379 (BM!), 8374–8378, 8380 (H!); **43** Forest east of Dakhwani, 11–12,000 ft (3340–3640 m), 1885, *J. F. Duthie* (DD!); **45** Dwali to Furkia, 3000–3500 m, 22 September 1957, *T. A. Rao* 4374 (BSD!); **48** Gori valley between Paton and Siba, 7–8000 ft (2130–2440 m), 22 August 1884, *J. F. Duthie* (BM!, DD!), and Badrinath, 1982, *S. P. Khullar* 5204 (PAN!); **54** Lete, south of Tukucha, Kali Gandaki, 10,000 ft (3040 m), 17 September 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 7898 (BM!, E!); **55** Annapurna Himal, Nardi Khola, 11,500 ft (3490 m), 20 September 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 8525 (BM!, E!); **65** Sikkim, 8000 ft (2440 m), September 1955, *D. S. Loyal* 69 (BM!, PAN 1228!).

Notes: Most records from mainland China appear to refer to the closely related *Dryopteris bonatiana*, but *D. panda* also occurs in SW. China, albeit uncommonly. The two can be easily confused and are difficult to distinguish on occasions.

Fig. 21 *Dryopteris panda.* India, Himachal Pradesh, north of Kulu, north of Manali, Rohtang Pass, 2 September 1978, *C. R. Fraser-Jenkins* 7739 (BM). Scale line = 1 cm.

20. Dryopteris himachalensis Fraser-Jenkins, **sp. nov.** **Fig. 22**

Planta in morphologia inter *D. chrysocomam* et *D. redactopinnatam* intermedia. Paleae stipitis, quam illae *D. chrysocomae* fusciorae, quam illae *D. redactopinnatae* dispersiorae. Lobi pinnarum minores, quam illi *D. chrysocomae* plus rectangulares, sed apice rotundati. Sori quam illi *D. redactopinnatae* praelongiori, sed quam illi *D. chrysocomae* minores. Sporae partiale abortivae. Cytotypus triploideus. Type: NW. India, Himachal Pradesh, north of Simla, north of Mandi, south side of the Rohtang Pass, 18 km above Manali, 5 km above Kothi, 2700 m, 2 September 1977, *C. R. Fraser-Jenkins* 6879 (BM! – holotype). A second specimen from the type locality, *C. R. Fraser-Jenkins* 6880, is in G!

Fronds medium-sized (up to *c.* 60 cm long), forming a spreading shuttlecock. Stipe ± thick, short, up to *c.* ¼ the length of the lamina, smooth, pale, densely clothed with narrowly lanceolate, mid-brown, matt scales, becoming smaller, narrow and less dense on the rachis. Lamina becoming twice pinnate below, narrowly lanceolate (up to *c.* 20 cm wide), tapered towards the base, bearing up to *c.* 15 pairs of nearly contiguous pinnae; pinnae ± linear, herbaceous, mid-green, matt and ± smooth above, bearing up to *c.* 12 pairs of medium-sized lobes or pinnules; pinna-lobes joined at their bases (which are widely attached to the costa) by a narrow wing of tissue except towards the bases of the lower pinnae where they become separated into pinnules, ± rectangular, slightly longer than broad, ± unlobed, pinnule apices rounded or rounded-truncate with rounded corners, bearing a few small, pointed teeth around the apex. Sori ± small, midway between the margins and centre of the lobes, few, not crowded, indusiate; indusia ± thick and slightly fleshy, pale-brown, slightly tall, turned down at the edges but not inflected, lifting very slightly at the edges when ripe, persistent. Spores irregular, with fully formed and a minority of abortive spores; fully formed spores somewhat large, fertile (see below).

Cytology: Triploid apomict (W. Himalaya: Gibby (1985)).

Ecology: A species of the upper mid-level forest zone, growing among trees, from *c.* 2500–2800 m alt.

Range: NW. India; China (Yunnan). A Sino-Himalayan species of the widespread sort.

Range in the Indian subcontinent: **35** As above.

Fig. 22 *Dryopteris himachalensis.* India, Himachal Pradesh, north of Kulu, above Manali, Rohtang Pass, 2 September 1977, *C. R. Fraser-Jenkins* 6880 (G). Scale line = 1 cm.

Notes: Dryopteris himachalensis is known only from the collection cited above and three specimens from Liking, Yunnan (*Feng* 8999, 9103; *Ching* 22212 A (PE!)), but could occur elsewhere in the west Himalaya, Yunnan and SE. Tibet, and possibly in the central Himalaya. Due to its intermediate morphology, the few plants found (in a forest in the process of unopposed felling), and the rather high proportion of abortive spores, the author at first thought that it was a hybrid between *D. chrysocoma* and *D. redactopinnata*, both of which (along with *D. stewartii, D. yigongensis, D. panda, D. barbigera* subsp. *barbigera, D. blanfordii* subsp. *blanfordii,* and *D. sublacera*) grow in the vicinity. However, the spores in *Fraser-Jenkins* 6880 appear to be unusually highly abortive compared to those in the type specimen and in the specimens in Peking, which all appear as in a normal apomictic species. When Prof. T. Reichstein of Basel (pers. comm.) was able to obtain easily a large number of young plants from the spores of *Fraser-Jenkins* 6880, it confirmed that the taxon should be treated as a species, as he had suggested.

It is placed in the section *Pandae* as being slightly nearer to *D. chrysocoma* than to *D. redactopinnata*, the two proposed ancestral species, though, as with other polyploids formed between species from different sections, this is somewhat arbitrary.

In a recent publication, Wang (1985) mentions 'Dryopteris pectinatopinnata Ching, ined.'; this name is written on the sheet of one of the above-mentioned specimens from Yunnan, and appears to be an invalid synonym of *D. himachalensis*.

21. **Dryopteris woodsiisora** Hayata **Fig. 23**

Icon. pl. formos. **6**: 158 (1916). Type: Taiwan, 'Habitat in rupibus Arisan', 2500 ft, June 1914, *U. Faurie* 518 (TI! – holotype).

Dryopteris tenuissima Tag. in *Acta phytotax. geobot. Kyoto* **1**: 308 (1932). – *Dryopteris tenuissima* forma *typica* H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 71 (1939 ['1938']), nom. inval. (Art. 24.3). Type: China, Manchuria, Kwantôsyû, Rankaton in Dairen, 24 October 1931, *M. Kobayasi* (KYO! – holotype).

Dryopteris tenuissima var. *serrata* Tag. in *J. Jap. Bot.* **13**: 185 (1937). – *Dryopteris tenuissima* forma *serrata* (Tag.) H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 71 (1939 ['1938']). Type: Korea, Mt Tyôzyu-san, prov. Kôkai, 29 July 1935, *G. Koidzumi* (KYO! – holotype).

Dryopteris neochrysocoma Ching in *Lingnan Sci. J.* **21** (1–4): 31 (1945). Type: China, Kwangtung, Jen-Hwa, Man Chi Shan, Shek Pik Ha village, *Tsang, W. T.* 26479 (SYS! – lectotype, selected here; MICH!, PE! – isolectotypes).

Misapplied names: Dryopteris chrysocoma auct., from lower levels in the central and east Himalaya; sensu Ching (1938), from SE. China. *Dryopteris costalisora* sensu Itô, Tagawa & Iwatsuki (1966).

Fronds small (up to *c.* 45 cm long), arching or frequently somewhat adpressed to rocks. Stipe thin, short to medium length, up to *c.* ½ the length of the lamina, glandular, somewhat densely scaly at the base with ovate-lanceolate, pale scales which become smaller, narrower and very scattered further up, where they are mixed with small, scattered, narrowly lanceolate scales which vary in colour from pale to very dark brown or blackish; rachis glandular, bearing a few scattered, narrow, pale or dark scales (usually at least some are dark). Lamina once pinnate, but a second time deeply pinnatifid, or just becoming bipinnate below, ± densely glandular below, especially on the costae, ± narrowly lanceolate (up to *c.* 15 cm wide), slightly tapered to a somewhat truncate base, bearing few (up to *c.* 15 pairs) ± separate pinnae; pinnae linear, tapering somewhat abruptly at their tips, fragile and easily broken, ± thinly herbaceous, mid-green above, glandular, devoid of scales, bearing rather few (up to *c.* 10 pairs) lobes, which extend to about two thirds the depth of the pinna on each side, or deeper in larger plants near the bases of the pinnae, where the lowest pair can just become separated into pinnules; pinnules or pinna-lobes slightly parallel-sided near their bases, slightly lobed at the sides in large plants, with rounded or rounded-truncate apices, usually bearing a few wide-based, usually somewhat obtusely pointed teeth or crenations around the apices, the teeth occasionally becoming more acute. Sori large, usually in pairs near the bases of the lobes, shortly above the costa, but singly per pinna-lobe in small plants, or in a row extending some way up the lobe in larger plants, frequently submarginal, indusiate; indusia slightly thick, white, but with the darker colour of the sporangia showing through as grey, becoming brown later, ± tall, inflected at the edges and

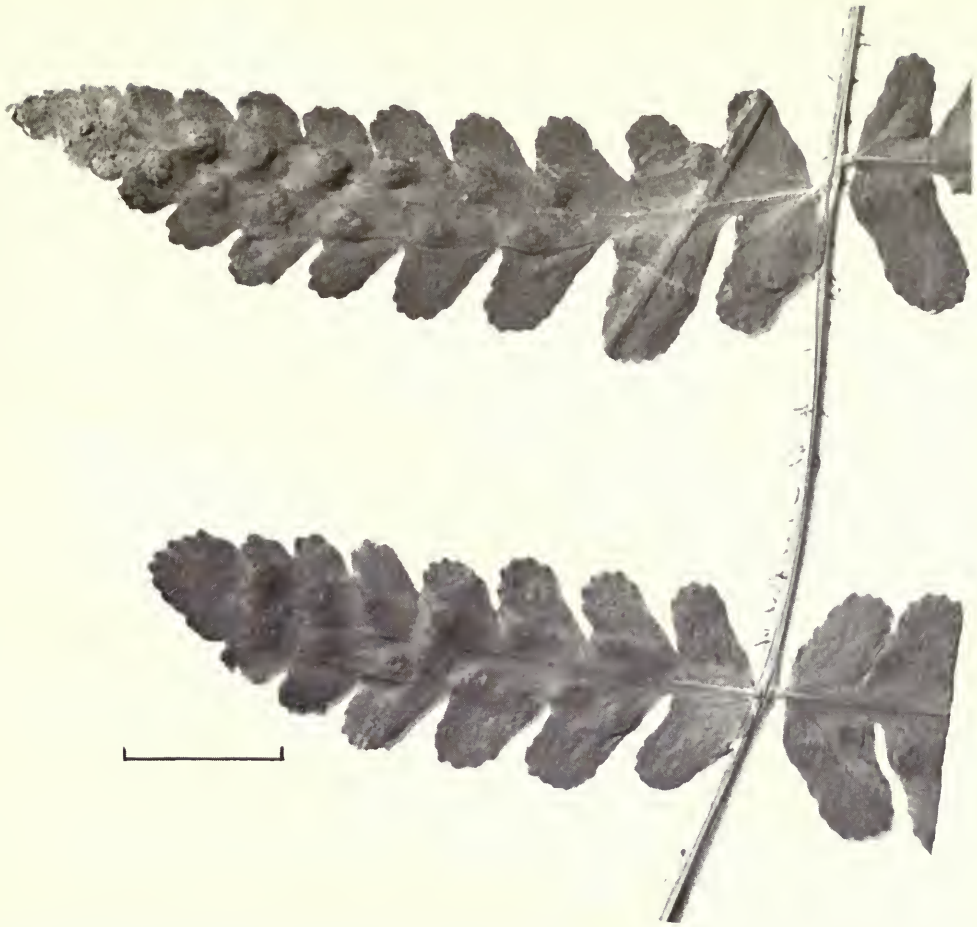

Fig. 23 *Dryopteris woodsiisora*. Nepal, near Pokhara, Sallyan, 6 September 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 7088 (BM). Scale line = 1 cm.

surrounding the sporangia even when ripe, persistent and not lifting or shrivelling. Spores regular, dark chestnut-brown, very large.

Cytology: Diploid (E. Himalaya: Gibby (1985)).

Ecology: A species of the lower mid-level forest belt, growing in moss beside boulders and in rock crevices in more or less vertical open places, or on roadsides, from *c.* 1300–2200 m alt.

Range: India (outer ranges in the eastern parts of the W. Himalaya; E. Himalaya in Sikkim and N. Assam; Assam); Nepal; Bhutan; SE. Tibet; China (Yunnan, Szechuan, Kweichow, Kiangsi, Kwangtung, Shantung, Liaoning); Taiwan; Mongolia; Korea; Thailand; Burma. A Sino-Himalayan species of the widespread sort with its range extending eastwards to SE. and NE. China.

Range in the Indian subcontinent: **37** Simla, Malthouse Khud, 6800 ft (2070 m), 14 September 1891, *T. Bliss* 93 (K!); **42** Bissone Hill, Tehri Garhwal (CAL!); **43** Gari, *Ghosh* (CAL!); **48** Rocks between Dandihat and Karela, 5–6000 ft (1520–1830 m), 2 October 1884, *J. F. Duthie* 3662 (CAL!, DD!, K!), and Kali valley, 7–8000 ft (2130–2440 m), 16 July 1886, *J. F. Duthie* 6287 (K!); **55** Sallyan, near Pokhara, 5000 ft (1520 m), 6 September 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 7088 (BM!, E!); **57** Sagu to Lukuwa path, 6500 ft (1980 m), 6 November 1961, *A. H. Norkett* 6857 (BM!); **58** Sandarijal, 5500 ft (1680 m), 21 August 1957, *R. L. Fleming* 1378 (KATH!, MICH!); **59** On way to Ramche, Rasuwa distr., Langtang, 1230–1800 m, 29 September 1977, *V. L. Gurung & party* 77/613 (KATH!); **62** Sinduwa,

Dhankuta District, 2100 m, 23 October 1963, *M. Togashi & T. Tuyama* 6305288 (KATH!); **64** Badamtan, Darjeeling, 28 August 1957, *D. S. Loyal* (PAN 2107!); **65** Gangtok, 1600 m, 15 June 1960, *H. Hara et al.* 2342 (BM!, KYO!); **74** Tawang to Pankinshow, Bomdila, *P. Chandra* 80402 (LWG!); **79** Kegwima edge, Naga Hills, 7000 ft (2130 m), 10 November 1885, *C. B. Clarke* 61873 (K!); **83** Sohra, 4000 ft (1220 m), 13 October 1872, *C. B. Clarke* 17500 B & D (BM!, K!).

Notes: Reported here for the first time from the Indian subcontinent where it has been completely overlooked and included within *Dryopteris chrysocoma*. Its small size, delicate, glandular fronds, more shallowly lobed pinnae with few sori and, in the Himalaya, its frequently dark, narrow, lower rachis and upper stipe scales readily distinguish it from *D. chrysocoma*. It also occurs at lower levels than *D. chrysocoma*. Some specimens from further east in China, etc., have mostly pale scales and only occasionally a few dark ones, as do some specimens from Khasia and occasional plants from elsewhere in the Himalaya. This does not appear to be of significance and the type of *D. tenuissima* from NE. China also has slightly dark upper scales while other specimens do not. The types of *D. neochrysocoma* and *D. woodsiisora* have pale scales.

Ching (1938) erroneously referred *D. tenuissima* to *D. panda* and later redescribed the species from cave-growing plants in SW. China as *D. neochrysocoma*. Specimens of *D. woodsiisora* are occasionally to be found in herbaria labelled as *D. panda*.

The NE. Chinese (etc.) populations are somewhat separated geographically from the southern ones, but there seems to be no morphological distinction between them, and the present author has little hesitation in treating them as belonging to the same species.

22. **Dryopteris austro-indica** Fraser-Jenkins, **sp. nov.** **Fig. 24**

Lastrea intermedia Beddome, *Ferns S. India*: 39, pl. 113 (1864), nom. illeg. (Art. 64.1), non C. Presl (1836), nec *Dryopteris intermedia* (Muhlenb. ex Willd.) A. Gray (1848). Type: India, Nilgiris, Mallee Mand, 6000 ft, *R.H. Beddome* (K! – lectotype, selected here).
Misapplied name: Dryopteris chrysocoma auct., southern India.

Planta *D. woodsiisorae* similis, sed stipite longiore basem versus paleis ovatis pallidis vestito, lamina brevi ovato-lanceolata lobis pinnarum confertis, differt. Cytotypus tetraploideus. Type: India, Madras [= Tamil Nadu], Nilgiris, Distr. Ootacamund, rocks at Craigmore, 7000 ft (2130 m), August 1886, *J. S. Gamble* 18041 (K! – holotype).

Fronds small (up to *c.* 35 cm long), ± upright. Stipe long, up to about the same length as the lamina, somewhat densely scaly at the base with ovate, glossy, pale scales, becoming smaller, narrower and very scattered further up and on the rachis, where they are very scattered. Lamina becoming twice pinnate below, but only deeply bipinnatifid elsewhere, lanceolate or somewhat ovate-lanceolate (up to *c.* 10 cm wide), tapered at both ends, with a somewhat wide base, bearing few (up to *c.* 12 pairs) slightly separate pinnae; pinnae elongated triangular-lanceolate with ± obtuse apices, somewhat thickly herbaceous, pale- to mid-green and matt above, bearing rather few (up to *c.* 7 pairs) crowded lobes or pinnules; pinna-lobes joined at their bases by a narrow wing of tissue, except at the bases of the lower and middle pinnae where they become separated into pinnules, though widely attached to the costa, lanceolate, with rounded or slightly obtusely pointed apices, the margins sometimes turned down, apices bearing a few insignificant, short, obtuse teeth. Sori large, crowded, in pairs, or frequently more, near the bases of the pinna-lobes near the pinna-costa, indusiate; indusia thick, white, with the dark colour of the sporangia showing through as grey, becoming brown, tall, inflected at the edges and surrounding the sporangia even when ripe, persistent and not lifting or shrivelling. Spores regular, dark chestnut-brown, very large.

Cytology: Tetraploid sexual (S. India (Shevaroys): Ghatak (1979), sub. *D. chrysocoma*, voucher specimen, *J. Ghatak* G.728 (CAL!, K!).

Ecology: A species of the mid-level forest belt, growing in open places beside boulders and in rock crevices, from *c.* 1550–2300 m alt.

Range: India (south). Apparently an endemic species of Sino-Himalayan affinity.

Fig. 24 *Dryopteris austro-indica.* [India, Tamil Nadu], Nilgiris, Mallee Mand, *Beddome* (K). Scale line = 1 cm.

Range in the Indian subcontinent: **93** On hill facing Archidia Estate, Shevaroy Hills, Salem district, shade of big boulders, 1550 m, 1 September 1964, *J. Ghatak* G.728, n = 82, 2n = 164 (CAL!, K!); **98** Gudalir Peak, Nilgherries, 6500 ft (1980 m), 15 June 1883, *H. C. Levinge* (K!).

Notes: Closer to *Dryopteris woodsiisora* than to *D. chrysocoma*, but its distinctive morphology and the fact that it is tetraploid suggest an allopolyploid origin involving a member of the *D. chrysocoma* group and possibly a species such as *D. cochleata*. A similar but distinct tetraploid plant (with darker upper stipe scales) from Yunnan has recently been described as *D. zinongii* Z. R. Wang & Fraser-Jenkins (Wang, 1985).

23. Dryopteris chrysocoma (Christ) C. Chr. **Fig. 25**

Index filic.: 257 (1905). – *Aspidium filix-mas* var. *chrysocoma* Christ in *Bull. Herb. Boissier* **6**: 966 (1898). – *Aspidium chrysocoma* (Christ) Christ in *Bull. Acad. int. Géogr. bot.* **11**: 253 (1902). – *Nephrodium chrysocoma* (Christ) Hand.-Mazz., *Symb. sin.* **6**: 24 (1929). Type: China, Yunnan, Mi Lê district, mt. forest, *A. Henry* 9957 (P! – holotype).

Dryopteris chrysocoma var. *major* Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 438 (1938). Type: India, Kumaon, *A. O. Hume* (SLBI! – lectotype, selected here).

Dryopteris chrysocoma var. *alpina* Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 438 (1938). Type: China, Yunnan, *H. T. Tsai* 59682 (PE! – lectotype (Wang, 1985)).

Dryopteris cochleata var. *squamosa* C. Chr. in *Acta Horti gothoburg.* **1**: 59 (1924). – *Dryopteris chrysocoma* var. *squamosa* (C. Chr.) Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 438 (1938). Type: China, Szechuan, Teng-hsiang-ying, 20 May 1922, *Harry Smith* 2012 (BM! – lectotype, selected here; PE! – isolectotype).

Dryopteris macrocarpa R. Stewart in *Bull. Torrey bot. Club* **72** (4): 406 (1945). Type: India, Dhurmsala, 10,000 ft, 18 October 1874, *C. B. Clarke* 24378 1/2 (K! – lectotype, selected here).

Dryopteris alpicola Ching & Z. R. Wang in Z. R. Wang in *Acta phytotax. sin.* **23** (5): 349 (1985). Type: as for *Dryopteris chrysocoma* var. *alpina*.

Misapplied names: Nephrodium filix-mas var. *schimperiana* sensu C. B. Clarke (1880), Beddome (1892), C. Hope (1903), non *Dryopteris schimperiana* (Hochst. ex A. Braun) C. Chr.; *Lastrea filix-mas* var. *elongata* sensu Beddome (1883), non *Polypodium elongatum* Aiton (= *Dryopteris aitoniana* Pichi Serm.).

Fronds medium to large (up to *c.* 120 cm long), ± upright, or often hanging over rocks. Stipe thick, of medium length, *c.* ¼ to ½ the length of the lamina, sparsely glandular, smooth, pale, densely clothed with a tuft of long, very narrowly lanceolate, crinkled, pale brown scales at the very base and lanceolate, pale- to mid-brown, glossy scales at the widest part of the base, which become smaller, scattered and mixed with very narrowly lanceolate, pale scales further up and on the rachis. Lamina becoming twice pinnate below, lanceolate or narrowly lanceolate (up to *c.* 27 cm wide), only very slightly tapered to a truncate base, bearing up to *c.* 25 pairs of separate pinnae (overlapping in large, well-developed fronds); pinnae ± linear, thickly herbaceous, pale green and matt above, with rather prominent, slightly impressed veins, sparsely glandular, bearing up to *c.* 15 pairs of somewhat large lobes or pinnules; pinna-lobes joined at their widely attached bases by a narrow wing of tissue except towards the bases of the pinnae where they become separated into pinnules, lanceolate (parallel-sided and ± rectangular in young plants),

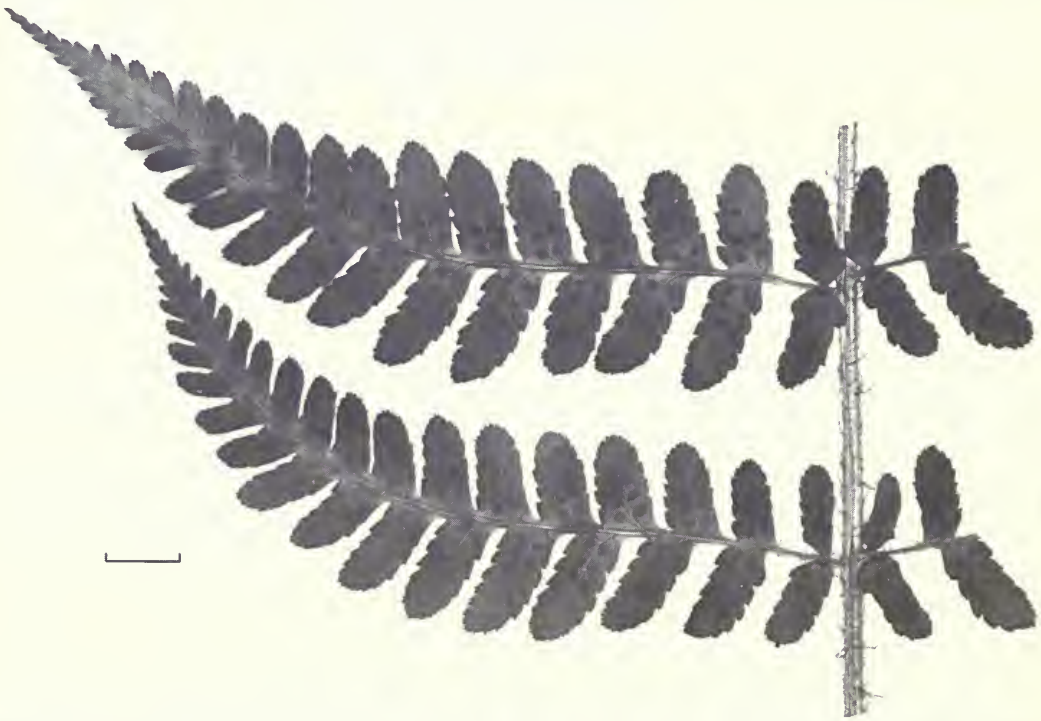

Fig. 25 *Dryopteris chrysocoma.* India, Himachal Pradesh, north of Kulu, north of Manali, Rohtang Pass, 1 September 1978, *C. R. Fraser-Jenkins* 7685 (FR). Scale line = 1 cm.

longer than broad, usually lobed with rounded lobes at the sides in large plants, pinnule apices rounded or obtusely pointed, bearing wide, obtusely pointed teeth around the apex except in occasional plants which may be almost devoid of teeth. Sori large, positioned in two short lines midway between the margins and centre of the lobes and usually absent from the tips of the lobes, becoming crowded together in plants from open places and high altitudes, indusiate; indusia thick and fleshy, white, with the dark colour of the sporangia showing through grey, becoming brown later, markedly tall, inflected at the edges and surrounding the sporangia even when ripe, persistent and not lifting or shrivelling. Spores regular, dark chestnut-brown, very large.

Cytology: Diploid sexual (W. Himalaya: Verma & Loyal (1960). Mehra & Khullar (1980), voucher specimen, *S. P. Khullar* 126 (PAN 5972!, 6070!). Gibby (1985). E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal*, August 1954 (PAN 1217!) and 3 August 1957 (PAN 2116!, 2174!, 2230!).

Ecology: A species of the mid-level forest belt, growing in open places, in moss beside boulders, in rock crevices, or at roadsides, from *c.* 1900–3500 m alt.

Range: Pakistan (Himalaya east of the Indus); India (W. Himalaya; E. Himalaya in Sikkim; Khasia); Nepal; Bhutan; SE. Tibet; N. Burma; SW. China (Yunnan, Szechuan, Kweichow); Philippines. Reported from S. India in error for *D. austro-indica*, and from E. China, Mongolia, Taiwan, and Thailand in error for *D. woodsiisora*. A Sino-Himalayan species of the widespread sort.

Range in the Indian subcontinent: **20** Sidundi Hill, Thandiani, 8000 ft (2440 m), 4 August 1956, *R. R. Stewart* 27661 (BM!, RAW!) and 15 August 1956, 27755 (BM!); **23** Rattan Pir, 8000 ft (2440 m), 24 August 1888, *E. W. Trotter* 234 (BM!, DD!); **30** Zanscar, north of Simla, *G. Watt* 5254 (K!); **32** Chamba, October 1897, *J. Marten* (K!); **33** Dharmsala, 10,000 ft (3040 m), 18 October 1874, *C. B. Clarke* 24378 1/2 (K!); **35** 5 km above Kothi, south side of Rohtang Pass, 10 km north of Mandi, north of Kulu, 2450 m, 1 September 1978, *C. R. Fraser-Jenkins* 7681–7683 (BM!), 7685 (FR!), 7681–7688 (H!); **37** Charabara, Simla, 8500 ft (2590 m), 17 August 1960, *S. S. Bir* 1503 (PAN 4008!, 4009!, 4255!, 4256!); **39** Mundali, Jaunsar (CAL!); **40** Tehri road, Mussoorie, 7000 ft (2130 m), 12 August 1959, *S. S. Bir* 1338 (PAN 2620!, 2621!, 3477!); **41** Kidarkanta (CAL!); **42** Gaurikund to Jangal Chatti, on path to Kedarnath Mt, north-east of Dehra Dun, *c.* 2000 m, 15 September 1977, *C. R. Fraser-Jenkins* 7189, 7190 (BM!); **43** Kunol, *Ghosh* (CAL!), and Badrinath, 1982, *S. P. Khullar* 52061 (PAN!); **45** Dwali, 2700 m, October 1966, *K. K. Dhir* 3338 (K!); **47** Cheena Peak, 8500 ft (2590 m), November 1979, *S. P. Khullar* 34 (PAN!); **48** Kali valley, 8–9000 ft (2440–2740 m), 18 September 1884, *J. F. Duthie* 3661 (BM!); **50** Dagun to Ghodilekh, 3300 m, 16 August 1972, *D. P. Joshi & M. S. Bista* 449 (KATH!); **51** Maharigaon, 10,500 ft (3190 m), 15 July 1952, *O. Polunin, W. R. Sykes & L. H. J. Williams* 188 (BM!, E!); **53** Lumsum, 7000 ft (2130 m), 27 August 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 4047 (BM!, E!); **54** Toketey, 12–14,000 ft (3640–4240 m), 21 February 1931, *Lall Dhwoj* 570 (BM!, E!); **59** Langtang, 28° 13′N, 85° 30′E, 3500 m, 11 September 1971, *J. F. Dobremez* 1116 (KATH!); **60** Chhumigaljo to Beding Rolwaling, 3400 m, 22 July 1977, *K. R. Rajbhandari & B. Roy* 1790 (KATH!); **62** Thudam, 3400 m, 22 June 1972, *H. Kanai et al.* 725241 (KATH!); **63** Sangure ridge to Dharan, 6000 ft (1830 m), 4 October 1978, *R. L. Fleming* 2624 (KATH!); **64** Kalpokhri to Sandakphoo, north of Tonglo, west of Darjeeling, 3000 m, 15 November 1978, *C. R. Fraser-Jenkins* 8481 (BM!); **65** Sikkim Himalaya, 1875, *Dr Treutler* (K!); **66** Yatung, 1897, *H. E. Hobson* (K!); **67** Honshu, (CAL!); **83** Maophlang, 5500 ft (1680 m), 18 October 1872, *C. B. Clarke* 18581 C (BM!).

Notes: Dryopteris chrysocoma (along with the related species in its group, *D. woodsiisora* and *D. austro-indica*) has markedly larger spores than any other *Dryopteris* species at the diploid level. Loyal (1981) has suggested that this may be related to its indehiscent indusia and probable mode of spore-dispersal by water. It is a variable species and some of the growth-stages, or forms, originating mainly because of growing conditions, have been named as varieties by Ching (1938). One such variety has also been named by Christensen (1924) as var. *squamosa* C. Chr. but is a single collection of young fronds of *D. chrysocoma* with somewhat glossy, dark russet-brown scales as occasionally occur in young plants of this species.

There also exists a complex of closely related species, with *D. woodsiisora* and *D. austro-indica* present in the Indian subcontinent, *D. zinongii* Z. R. Wang & Fraser-Jenkins in Yunnan and Szechuan, and *D. fangii* Ching, Fraser-Jenkins & Z. R. Wang (= *D. chrysocoma* var.

gracilis Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 437 (1938)) in Yunnan, W. China, all four of which have previously been included together under *D. chrysocoma*. It is possible that some of these have diverged from an ancestral stock and become ecologically and morphologically distinct, but more investigation into their cytology is needed to help clarify this, and whether some should perhaps be treated as subspecies of *D. chrysocoma*. Wang (1985), whose cytological investigations revealed the existence of the complex in China, has also discovered the hybrid, *D.* × *daliensis* Z. R. Wang (almost certainly *D. para-chrysocoma* or *D. chrysocoma* × *D. zinongii*), which is one of the syntypes of Ching's var. *alpina* (*Tsoong* 2270 (PE!)), and Fraser-Jenkins has discovered a specimen of a *D. fangii* hybrid in China (no. 3563, herb. Szechuan Forest Research Institute, Chengdu!). Wang also contends, perhaps correctly, that the common Indo-Himalayan plant is not true *D. chrysocoma*, but a new species, *D. para-chrysocoma* Ching & Z. R. Wang, which however is extremely close in morphology to the Chinese *D. chrysocoma* and requires further investigation to prove its distinctness. I do not agree with Wang that *D. alpicola* Ching & Z. R. Wang (= *D. chrysocoma* var. *alpina* Ching) is distinct from (Chinese) *D. chrysocoma*. Two other names given as nomina nuda by Wang (1985) are *D. pseudochrysocoma* Ching and *D. pectinatopinnata* Ching; the first I do not know (though I did not see any other taxa in the group in Peking), but the second appears to be the same as *D. himachalensis*. I could not treat these in my classification (Fraser-Jenkins, 1986).

Spore dispersal in *D. chrysocoma* has been investigated by Loyal (1981, 1985) and appears to involve water dispersal from rotting fronds.

24. **Dryopteris nobilis** Ching **Fig. 26**

in *Bull. Fan meml Inst. Biol* (Bot.) **11**: 65 (1941). Type: China, NW. Yunnan, Kung Shan, Changmutong, Salween river valley, 2200 m, *K. M. Feng* 7991 (PE! – lectotype, selected here; PE! – isolectotypes).

Dryopteris nobilis var. *fengiana* Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **11**: 67 (1941). Type: China, NW. Yunnan, Kung Shan, Hai-Poo Shan, Tze-Kai, south of Changmutong, west bank of Salween river, *K. M. Feng* 8449 (PE! – holotype).

Fronds medium-sized (up to *c.* 100 cm long). Stipe thick, pale-coloured, medium to long, *c.* ½ the length of the lamina, somewhat densely scaly at the base, with thin, pale- to mid-brown, ovate, ± adpressed scales, which become smaller, ovate-lanceolate, and scattered further up the stipe; rachis bearing a very few scattered, small, narrow scales. Lamina twice pinnate below, elongated triangular-lanceolate to triangular-lanceolate (up to *c.* 27 cm wide), only very slightly tapered to a truncate or widely truncate base, bearing up to *c.* 24 pairs of ± contiguous pinnae (occasionally overlapping in large foliose fronds); pinnae slightly tapering from a slightly wider base, thick, somewhat crispaceous, mid-green and matt above, with prominent, slightly impressed veins, bearing up to *c.* 14 pairs of somewhat large lobes or pinnules; pinna-lobes joined at their widely attached (to the costa) bases by a ± narrow wing of tissue except towards the bases of the pinnae where they become fully separated into pinnules, ± rectangular to triangular-lanceolate, longer than broad, the lower ones on each pinna frequently extended on the basiscopic side of the lower pinnae (up to nearly twice the length of the acroscopic ones) and also frequently curved towards the pinna-apices, ranging from unlobed to lobed up to half their depth with large, rounded-rectangular lobes, pinnule apices usually wide, rounded, or occasionally ± obtusely pointed, bearing numerous small, narrowly acute teeth around the apex, which have somewhat extended, aristate, hair-pointed tips. Sori somewhat small, in two slightly curved rows, one on each side, midway between the margins and centre of each pinnule, extending the whole length of the pinnule, not crowded, indusiate; indusia curved but not inflected at the edges, somewhat thick, white, becoming brown later, lifting and shrivelling slightly, but mostly persistent. Spores regular.

Cytology: Unknown.

Ecology: A species of lower mid-level forests, growing on the ground, from *c.* 1400–2000 m alt.

Range: India (E. Himalaya in Sikkim; Assam, rare); SE. Tibet; SW. China (Yunnan). A

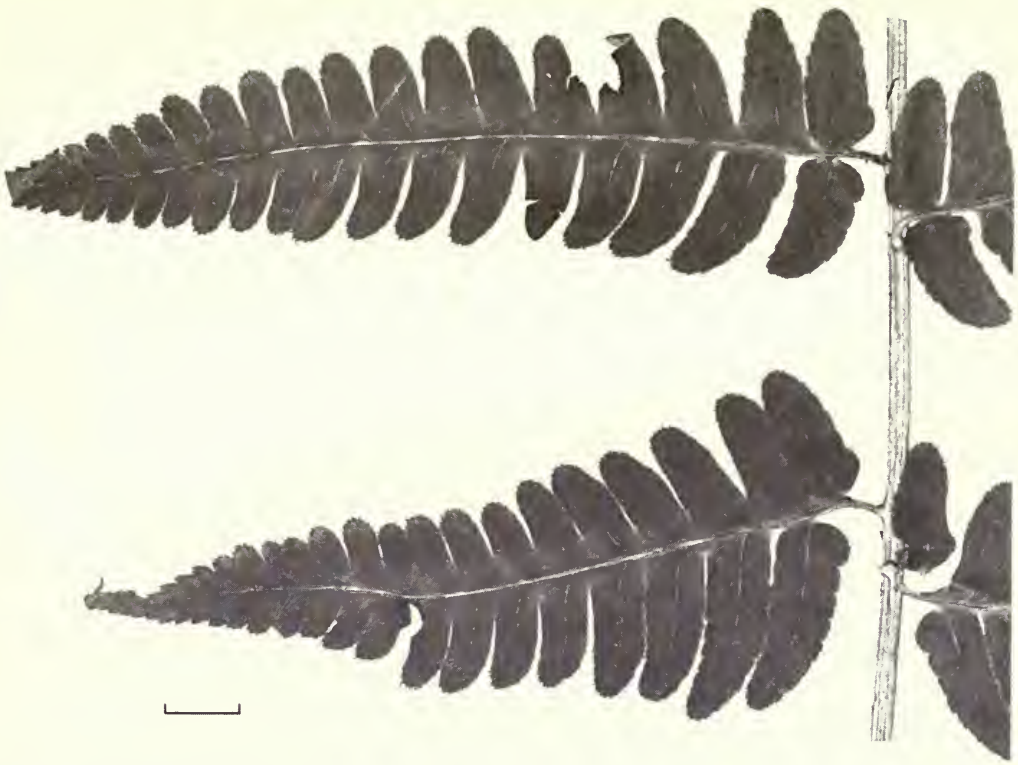

Fig. 26 *Dryopteris nobilis*. SE. Tibet, Pome, Trulung, 12 January 1947, *F. Ludlow, G. Sherriff & H. H. Elliot* 12136 (BM). Scale line = 1 cm.

Sino-Himalayan species presumably of the east Himalayan sort, though it has not yet been found in the E. Himalaya on the Indian subcontinent side of the border.

Range in the Indian subcontinent: **65** Kurseong, 4500 ft (1370 m), 6 October 1882, *H.C. Levinge* (DUB!); **82** Cachar, 1864, *James Hutton* (MANCH!); **83** Khasia Hills, *Mr Riddel* 103 (K!).

Notes: A distinct though rare species, reported here for the first time from the Indian subcontinent, where it is known from only three collections.

Section 4. Dryopteris

25. **Dryopteris filix-mas** (L.) Schott **Fig. 27**

Gen. fil. **1**: 9 (1834).
For basionym and synonymy see Fraser-Jenkins (1983).

Fronds medium to large (up to *c.* 85 cm long). Stipe ± thick and short, *c.* ¼–⅓ the length of the lamina, the base densely clothed with large, lanceolate to ovate-lanceolate, pale- to mid-brown scales, mixed with smaller, very narrow ones, becoming slightly smaller and slightly more scattered further up on the stipe and on the rachis. Lamina twice pinnate, ± narrowly lanceolate (up to *c.* 25 cm wide), tapered slightly towards the slightly truncate base, bearing up to *c.* 27 pairs of ± contiguous pinnae; pinnae linear-lanceolate, herbaceous, pale- to mid-green above, ± glabrous apart from a few small, scattered, very narrow or almost hair-like, pale scales on the costae, bearing many (up to *c.* 20 pairs), somewhat small pinnules; pinnules ± short, longer than broad, widely attached to the costa and those near the tips of the pinnae becoming fused together at their bases by a narrow wing of tissue, but those at the bases of the lower pinnae becoming narrowly attached or stalked, ± crowded, somewhat parallel-sided near their bases,

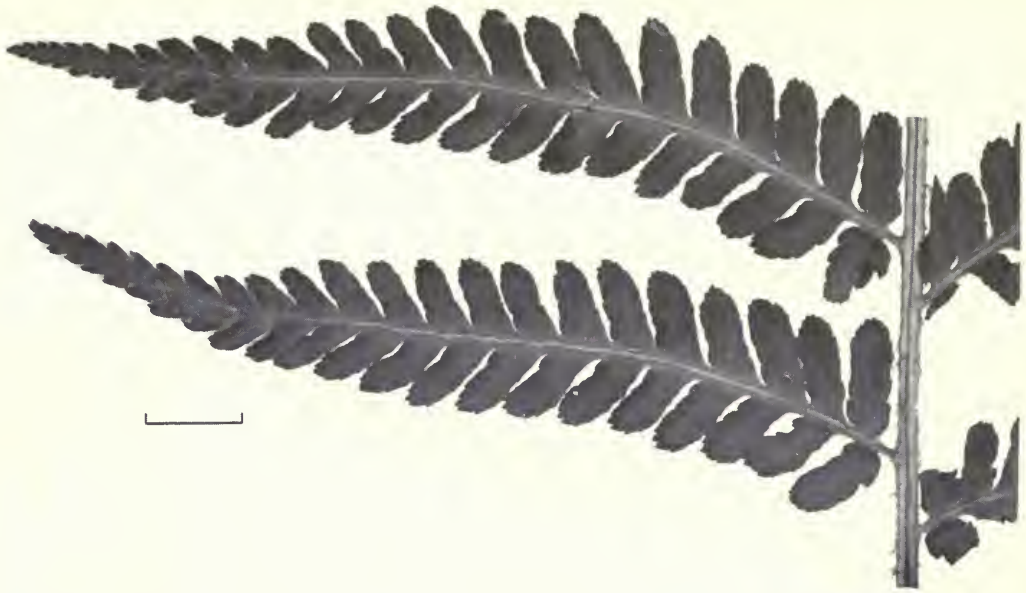

Fig. 27 *Dryopteris filix-mas*. India, Kashmir, Sonamarg, 20 August 1946, *R. R. Stewart* 22391 (RAW). Scale line = 1 cm.

but tapering above, very shallowly lobed, with ± pointed lobes in the distal part of the pinnules, each lobe ending in an acute tooth, pinnule-apices ranging from rounded to obtusely pointed (rarely ± truncate, mainly in small plants in exposed places) and bearing somewhat long, acute teeth. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule midway between the centre and the margins, indusiate; indusia slightly curved down at the edges, thin, shrivelling to about half their size and lifting, mostly deciduous later in the season. Spores regular.

Cytology: Tetraploid sexual (Europe: Manton (1950), etc. N. America: Wagner & Hagenah (1962), etc. N. Pakistan: Gibby (1985)).

Ecology: In the Indian subcontinent a species of open, rocky areas and roadsides above the forest zone, growing beside rocks, from *c.* 2700–3900 m alt. In Europe widespread from sea-level upwards, often in forests or woodland.

Range: N. America; Greenland; S. America (?Andes in Argentina); Europe except the extreme south; NW. Africa; western Asia; U.S.S.R. (European Russia, Caucasus, W. Siberia, Kazakhstan, Tien Shan, Altai, Irkutsk); NE. China (Tien Shan); N. Iran (rare and confused with *Dryopteris caucasica* (A. Braun) Fraser-Jenkins & Corley, etc.); NE. Afghanistan; Pakistan (Himalaya west and east of the Indus); India (NW. Himalaya). A European species which reaches the New World and the W. Himalaya but otherwise remains in the area of the European type flora.

Range in the Indian subcontinent: **2** Prov. Kunar, 'Bashgal-Quelltäler, unteres Pushal-Tal, bei der Heissen Quelle, "Garm Chashma"', *D. Podlech* 16603 (M!); **13** Lowarai Pass, Chitral, 9500 ft (2890 m), 15 June 1895, *Sgn-Lt S. A. Harriss* 16854 (BM!, DD!); **14** Swat, Sho Nala, 9–10,000 ft (2740–3040 m), *R. R. Stewart & A. Rahman* 25180 (BM!); **15** Naltar valley, Gilgit, 12–13,000 ft (3640–3940 m), 21 July 1954, *R. R. Stewart* 26697a (BM!, RAW!); **19** Burzil Chowki, Gilgit Road, 10,500 ft (3190 m), 26 July 1940, *R. R. Stewart* 19782 (PE!); **20** 1 km below Lake Saif-ul-Malluk, 5 km above Naran, upper Kunhar (Kagan) valley, Hazara, 3000 m, 10 August 1977, *C. R. Fraser-Jenkins* 6363, 6364 (BM!), 6363 (PE!), 6364 (Herb. T. Reichstein, Basel!); **21** Jander Nar, ± 11,500 ft (3490 m), 27 June 1978, *Shahzad Iqbal & Ayaz Abani* 1887 (ISL!); **24** Prope Hirpour, Pir Punjal, *V. Jacquemont* 586 (38) (K!) and Gulmarg, 9–10,000 ft (2740–3040 m), 9 July 1898, *G. A. Gammie* (B!); **25** Ascent, Rajdhiangan Pass, Kishenganga valley and road to Nanga Parbat, 10,000 ft (3040 m), 31 August 1939, *R. R. Stewart* 19304 (CAL!, RAW!); **26**

Sonamarg, 9000 ft (2740 m), 20 August 1946, *R. R. Stewart* 22391 (PE!, RAW!); **29** 1 km west of Meenamarg, east side of Zogila Pass, Sonamarg to Kargil, north-east of Srinagar, 3250 m, 26 August 1977, *C. R. Fraser-Jenkins* 6518 (BM!).

Notes: Similar when young to young plants of *Dryopteris blanfordii*, but that species has darker, thinner, more glossy scales and usually shows some sign at the base of the lamina of its more deeply lobed pinnules, even when very young.

D. filix-mas is the only European *Dryopteris* to reach the Himalaya, perhaps due to an ability to withstand harsh conditions. Its considerable range worldwide probably also reflects this, though it is not present in the Far East, from where (E. Siberia, Manchuria, E. China, Korea, and Japan) it has been reported in error for *D. sichotensis* V. Komarov (= *D. coreano-montana* Nakai, *D. barbellata* Fomin).

The plant from the eastern part of the U.S.A. and Canada differs slightly from the normal plant, as found in Europe and the western U.S.A., in being more lobed, but, from its chemistry and from cytological studies of hybrids involving *D. filix-mas* from various areas (Wagner, 1971), this does not appear to be of much significance.

In the Indian subcontinent, earlier authors, with a much wider species concept than today, referred many *Dryopteris* species to *D. filix-mas* or varieties of it (e.g. *Nephrodium filix-mas* var. *normalis* C. B. Clarke = *D. juxtaposita*). The relative rarity of true *D. filix-mas* combined with the rejection of most earlier records has led to its being overlooked there, except by Hope (1903), who correctly recorded it. The only modern records are those of Stewart (1957, 1972), who referred it to *D. oreades* Fomin, following Alston's erroneous identification of his specimens. It is thus accurately reported here from the Himalaya for the first time since Hope.

In Europe four distinct species were generally included under the name *Dryopteris filix-mas* and though each of these had been recognised at some time by various authors in the last century, it was not until the cytological investigations of Manton (1950) that true *D. filix-mas* was separated from two of them, namely *D. affinis* (Lowe) Fraser-Jenkins (synonyms: *D. pseudo-mas* (Wollaston) Holub & Pouzar, *D. borreri* (Newman) Newman ex Tavel), a member of the section *Fibrillosae*, and *D. oreades* Fomin (synonym: *D. abbreviata* auct., non (DC.) Newman ex Manton). Hence, species such as *D. wallichiana* in the section *Fibrillosae* have until now generally been referred to the *D. filix-mas* group.

It has been shown (Manton, 1950; Manton & Walker, 1954; Fraser-Jenkins, 1976; and see Lovis, 1977) that *D. filix-mas* is a sexual allotetraploid species (actually a segmental allopolyploid) derived from the sexual diploid, European and W. Asian species, *D. oreades* and the fourth species included in the *D. filix-mas* group, *D. caucasica* (A. Braun) Fraser-Jenkins & Corley, of SE. Europe (rare) and SW. Asia, neither of which occurs in the Indian subcontinent. Chemical studies (Widén, Vida, von Euw & Reichstein, 1971; Widén & Britton, 1971; Widén, Fraser-Jenkins, Lounasmaa, von Euw & Reichstein, 1973), as well as cytological studies involving hybrids, have confirmed the presumed origin of the species. It is therefore the only polyploid *Dryopteris* species present in the Indian subcontinent whose origin has been resolved.

26. Dryopteris serrato-dentata (Beddome) Hayata **Fig. 28**

Icon. pl. formos. **4**: 179, fig. 116 (1914). – *Lastrea filix-mas* var. *serrato-dentata* Beddome, *Suppl. ferns Brit. Ind.*: 55 (1892). – *Nephrodium serrato-dentatum* (Beddome) C. Hope in *J. Bombay nat. Hist. Soc.* **12**: 622, pl. 10 (1899). – *Dryopteris filix-mas* var. *serrato-dentata* (Beddome) Hayata in *J. Coll. Sci. imp. Univ. Tokyo* **30**: 416 (1911). Type: India, 'Sikkim Himalaya', [*Beddome*] (BM! – lectotype, selected here).

Woodsia veitchii Christ in *Bull. Acad. int. Géogr. bot.* **16**: 121 (1906). Type: China, Szechuan, Wu Shan, moist rocks, 3 July 1903, *E. H. Wilson* 5400 (K! – lectotype, selected here; BM!, PE! – isolectotypes).

Misapplied names: Lastrea filix-mas var. *odontoloma* (Beddome) Beddome sensu Beddome (1876); *Nephrodium odontoloma* (Beddome) C. B. Clarke sensu C. B. Clarke (1880).

Fronds somewhat delicate, small (up to *c.* 60 cm long), arising in a group or small basket from the rhizome apex. Stipe thin, long, about the same length as, or longer than, the lamina, the base bearing ± small, lanceolate, or sometimes ovate-lanceolate, pale- to mid-brown scales, which sometimes become dark brown, but not black, and become very scattered, small and narrow

Fig. 28 *Dryopteris serrato-dentata.* Pakistan, Hazara, upper Kunhar (Kagan) valley, Naran, Saif-ul-Malluk, 10 August 1977, *C. R. Fraser-Jenkins* 6384 (BM). Scale line = 1 cm.

further up and on the rachis where they become almost hair-like, with only a very few left, scales partially deciduous, stipe, rachis and pinna-costae furnished with ± scattered glands which give the frond a sweet scent when young. Lamina frost-sensitive, fragile, twice pinnate, triangular-lanceolate or occasionally elongated triangular (up to *c.* 15 cm wide), not tapered towards the base, bearing few (up to *c.* 12 pairs) ± contiguous pinnae; pinnae elongated triangular-lanceolate, herbaceous, or often slightly crispaceous, pale- to mid-green above, ± glabrous, bearing rather few (up to *c.* 16 pairs) ± small pinnules; pinnules short, widely attached to the costa, those in the upper part of the pinna becoming fused together at their bases by a narrow wing of tissue, but those at the bases of the lowest few pinnae becoming narrowly attached or stalked, usually crowded though they become separate in larger plants, ± rectangular with parallel sides, lobed or unlobed, the lobes ± truncate and bearing a few long-acute teeth, pinnule-apices ranging from truncate to rounded, bearing long-acute, ± splayed-out teeth. Sori somewhat small, not crowded, in two rows, one on each side midway between the centre and margins of the pinnules, indusiate; indusia ± small, flat, thin, with jagged edges, shrivelling markedly and usually deciduous. Spores regular.

Cytology: Tetraploid sexual (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal* 65, September 1955 (PAN 1198!) and 1956 (PAN 2221!) and 37, 12 August 1957 (PAN 2178!). Gibby (1985)).

Ecology: A species of high levels, growing in crevices among open rocks, or rarely on the ground, from *c.* 3100–5000 m alt.

Range: Pakistan (Himalaya east of the Indus); India (W. Himalaya; E. Himalaya in Sikkim and N. Assam); Nepal; ?Bhutan; S. and SE. Tibet; N. Burma; China (Yunnan, Szechuan); Taiwan. A Sino-Himalayan species of the Tibetan sort, also occurring in Taiwan.

Range in the Indian subcontinent: **20** Cliff above Lake Saif-ul-Malluk, 6 km above Naran, upper Kunhar (Kagan) valley, 3100 m, 10 August 1977, *C. R. Fraser-Jenkins* 6383, 6384 (BM!), 6384 (PE!); **26** Cliff, east side of upper Chatponsal Nullah, nr Bajipath, north-east of Pahlgam, Liddar valley, 3400 m, 21 August 1978, *C. R. Fraser-Jenkins* 7477, 7479 (PE!), 7478, 7480–7488 (H!), 7480, 7484 (BM!); **32** 2 km below Satrundi, north of Tissa, north of Ravi valley, north-west of Chamba, 3300 m, 10 September 1978, *C. R. Fraser-Jenkins* 7807, 7809, 7811 (BM!), 7807–7811, 7813, 7814, 7817–7822 (H!); **33** Laka, Dhurmsala, 11,000 ft (3340 m), 17 October 1874, *C. B. Clarke* 24582 (BM!, K!) and 7 October 1874, 28347 (K!); **35** Solang, Kulu, 13,000 ft (3940 m), 23 September 1916, *R. E. Cooper* 5672 (E!); **36** Lahoul, Sisu, 11,000 ft (3340 m), 24 July 1930, *W. N. Koelz* 643 (MICH!, PE!); **41** Moraine of Dudu Glacier, under Sri Kanta, 14–15,000 ft (4240–4540 m), 10 August 1883, *J. F. Duthie* 394 (DD!, K!); **43** East of Bhowani, Garhwal, 13,000 ft (3940 m), 16 September 1885, *J. R. Reid* (E!); **45** Pinsara Pass, 10,000 ft (3040 m), October 1875, *Col. Davidson* (DD!); **48** Ralam valley, 12–13,000 ft (3640–3940 m), 23 August 1884, *J. F. Duthie* (DD!); **51** Thakurji Lekh, 14,500 ft (4390 m), 1 October 1952, *O. Polunin, W. R. Sykes & L. H. J. Williams* 5491 (BM!, E!); **57** Seng Khola, 15,000 ft (4540 m), 9 August 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 3806 (BM!, E!); **59** Langtang Himal, 14,500 ft (4390 m), 1 August 1962, *J. D. A. Stainton* 4092 (BM!); **60** Khumbukarna Himal, Makalu, upper Barun valley, 5100 m, 19 September 1972, *T. Wraber* 235 (34542) (BM!); **62** Thudam to Kipudonsu, 3400–4200 m, 26 June 1972, *H. Kanai et al.* 725268 (KATH!); **64** Tonglo, Darjeeling, 10,000 ft (3040 m), July 1880, *H. C. Levinge* 8242 (K!); **65** Chola, 15,000 ft (4540 m), December 1971, *H. J. Elwes* (K!); **66** Gantsa, Chumbi valley, 12,000 ft (3640 m), 20 June 1945, *N. L. Bor & Kirit Ram* 20505 (BM!); **74** Pankinshow, Tawang Subdivision, Bomdila, *P. Chandra* 80409 (LWG!).

Notes: Dryopteris serrato-dentata can be distinguished from *D. acuto-dentata* by its shorter, wider-based frond, and pinnules with more side-lobes; the stipe also bears fewer and somewhat paler scales.

Mehra & Loyal (1965) report diploid, triploid, and tetraploid plants of *D. serrato-dentata*, but their triploid (voucher specimens in PAN!) is *D. acuto-dentata*. Unfortunately their voucher specimens of the diploid (PAN!) are too poor and fragmentary to be identifiable, though it is possible that they represent *D. alpestris*. However, in the light of their report, further work is required into *D. serrato-dentata* (which shows some variation in scale colour and frond size) to examine the possibility that a closely related diploid species could exist, which is at present included within it.

27. Dryopteris alpestris Tag. **Fig. 29**

in *Acta phytotax. geobot. Kyoto* **3**: 88 (1934). Type: Taiwan, Mt Daisuikutu-zan, prov. Taityu, 7 July 1933, *J. Ohwi* 3801 (KYO! – holotype).

Dryopteris doshunglaensis Ching & S. K. Wu, *Enum. vasc. pl. Xizang (Tibet)*: 26 (1981), nom. nud. (Art. 32.1). Specimens in PE!.

Fronds delicate, small (up to *c.* 30 cm long), upright, arising in groups from the apices of a thin, branched rhizome creeping below the soil surface. Stipe thin, long, up to about the same length as the lamina, the base clothed with ± large, thin, ovate, pale- to mid-brown scales, sometimes with dark brown or blackish central and basal regions (in the eastern part of its range), becoming few, very scattered and smaller further up the stipe, rachis ± without scales, stipe, rachis and pinna-costae furnished with glands. Lamina markedly frost-sensitive, thin, twice pinnate, lanceolate to ovate-lanceolate (up to *c.* 7 cm wide), tapering towards the base, bearing few (up to *c.* 15 pairs) ± separate pinnae; pinnae linear-lanceolate, ± thinly herbaceous, pale- to mid-green above, ± glabrous, bearing few (up to *c.* 5 pairs) small pinnules; pinnules short, widely attached to the costa except at the bases of the pinnae where they are narrowly attached or stalked at the bases of the lowest pinnae, widely lanceolate with wide bases, shallowly lobed with wide, rounded-truncate lobes, bearing a few long-acute teeth, pinnule-apices rounded, bearing numerous prominent, long-acute teeth spread out in a fan-like arrangement. Sori small, well spaced out, in two rows, one on each side midway between the centre and margins of the pinnules, indusiate; indusia small, flat, very thin, shrivelling markedly and usually deciduous. Spores regular.

Cytology: Unknown, but perhaps diploid sexual (see under *D. serrato-dentata*), which would be supported by the small size of its spores.

Ecology: A species of high-level meadows, growing on the ground between bushes and rocks in open places, from *c.* 3300–4500 m alt.

Range: India (E. Himalaya in Sikkim and ? N. Assam); Nepal; ?Bhutan; SE. Tibet; N. Burma; China (Yunnan); Taiwan. A Sino-Himalayan species of the Tibetan sort, also occurring in Taiwan.

Range in the Indian subcontinent: **60** Mt Everest expedition, 13–14,000 ft (3940–4240 m), August 1921, *A. F. R. Wollaston* (K!); **62** Bhalukhop to Jumley, 13,400 ft (4060 m), 24 July 1971, *T. B. Shrestha & D. P. Joshi* 299 (KATH!); **65** Chola range, Chakunchu, 11–12,000 ft (3340–3640 m), 30 July 1910, [*Kari*] '*Collecteur de Darjeeling*' 3971 (BM!, P!).

Notes: Dryopteris alpestris is reported from the Indo-Himalaya for the first time here. Some, but not all, plants in the eastern part of its range (Tibet and Yunnan) have dark scales, a feature also observed in a few other Tibetan species of *Dryopteris* and *Polystichum*, but which does not appear to be of much taxonomic significance. *D. alpestris* may be the plant referred to by Mehra & Loyal (1965) as their diploid '*D. serrato-dentata*', but their voucher specimens (PAN!) are merely fragments, too difficult to be identified. In herbaria, *D. alpestris* has usually been confused with young specimens of *D. barbigera* (particularly subsp. *komarovii*), from which it can be distinguished by its thin stipes bearing only a few scattered, ovate scales in the mid and upper regions, in addition to its delicate, nearly scaleless fronds. It is also superficially similar to *Athyrium davidii* (Franchet) Christ (= *A. duthiei* Beddome), another somewhat little known, high-level Tibetan type of species from the Himalaya and SW. China, which differs from it in having oval, exindusiate sori and obtuse pinnule-teeth. *D. alpestris* can readily be distinguished from *D. serrato-dentata* by its thinner texture and more delicate fronds with narrower bases and longer, more splayed-out pinnule-apex teeth; the distinctive large, ovate stipe-scales are also quite different.

28. Dryopteris barbigera (T. Moore ex Hook.) Kuntze

Revis. gen. pl. **2**: 812 (1891). – *Nephrodium barbigerum* T. Moore ex Hook., *Sp. fil.* **4**: 113 (1862). – *Lastrea barbigera* (T. Moore ex Hook.) Beddome, *Ferns Brit. India* **2**: 227, pl. 227 (1867). – *Aspidium*

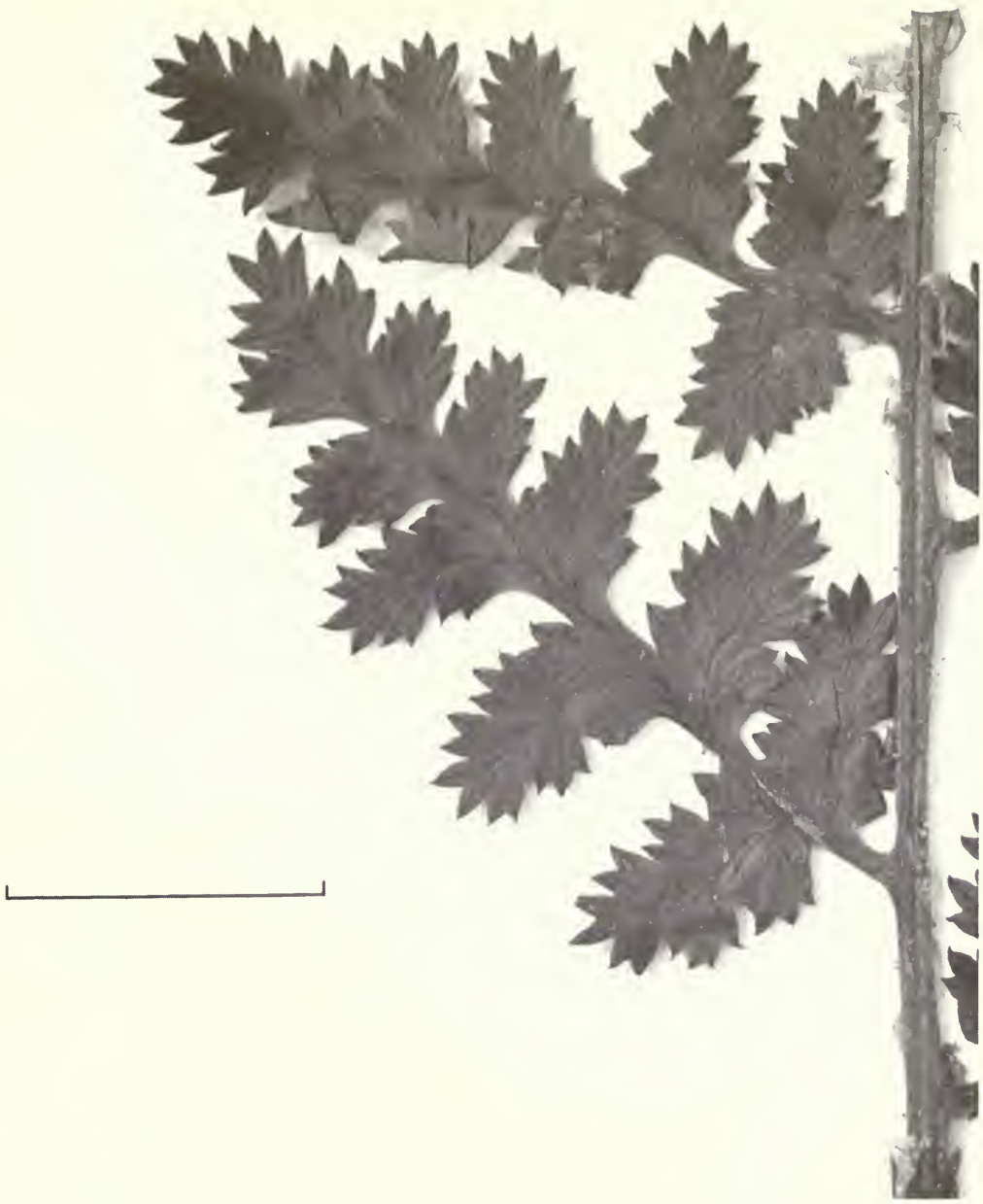

Fig. 29 *Dryopteris alpestris*. Burma, Nam Tawai valley (Ka-Karpo-Razi), 28° 15′N, 97° 30′E, 8 October 1937, *F. Kingdon-Ward* 13383 (BM). Scale line = 1 cm.

barbigerum (T. Moore ex Hook.) Christ, *Farnkr. Erde*: 260 (1897). Type: India, 'Sikkim, regio subalpina alt. 12–13000 ped. coll. J.D.H.' (K! – lectotype, selected here).

This species is divided here into two subspecies, which until now have been ignored in the Indian subcontinent, or described independently as species from elsewhere. Some intermediates exist between them but they are usually separable even though they differ in only minor details. They probably originated as ecotypes which diverged from one stock in response to different ecological conditions and are now more or less well separated.

28a. Dryopteris barbigera subsp. **barbigera** **Fig. 30**

Nephrodium falconeri Hook., *Sp. fil.* **4**: 123, pl. 254 (1862). – *Lastrea falconeri* (Hook.) Beddome, *Ferns Brit. India* **1**: 41, pl. 41 (1865). – *Dryopteris falconeri* (Hook.) Kuntze, *Revis. gen. pl.* **2**: 812 (1891). Type: India, Kashmir, *Falconer*, Herb. Hooker (K! – lectotype, selected here; BM!, K! – isolectotypes).

Fronds medium to large (up to *c.* 115 cm long), forming a basket from a thick creeping rhizome with an ascendent apex. Stipe thick, long, *c.* ⅔ the length of the lamina, very densely scaly at the base with large, ovate-lanceolate, thick, somewhat glossy, pale brown or often somewhat russet-brown scales, which remain dense, but become slightly narrower and shorter further up the stipe and on the rachis, where they are smaller and intermixed with long, very narrow scales which become paler and very narrowly hair-like further up; stipe and rachis somewhat densely furnished with glands between the scales, as are the pinna-costae and underside of the lamina, so that the whole frond is sweetly fragrant when young. Lamina markedly frost-sensitive and rapidly becoming brown in autumn, twice pinnate, becoming a third time pinnatifid below in large plants, ovate-lanceolate (up to *c.* 30 cm wide), with a somewhat widely truncate base and an abruptly and obtusely tapering apex, bearing up to *c.* 25 pairs of ± contiguous pinnae; pinnae linear-lanceolate or linear, ending somewhat abruptly at their short apices, herbaceous or slightly crispaceous, pale- to mid-green above, bearing numerous scattered, small, very narrowly hair-like, pale brown scales on the costae and scattered over the lamina, particularly on the underside, bearing many (up to *c.* 20 pairs) medium-sized pinnules; pinnules narrow, markedly longer than wide, narrowly attached or stalked towards the bases of the pinnae, those nearer the pinna-apices becoming widely attached, lanceolate, deeply lobed with small, narrow, ± crowded lobes ending in a few long-acute teeth, pinnule-apices rounded or obliquely pointed, bearing numerous, usually markedly long, lanceolate teeth, spread out in a fan-like arrangement and ending rather abruptly in narrow, aristate tips. Sori small, usually well spaced out, in two rows, one on each side midway between the centre and margins of the pinnules, indusiate; indusia small, flat, thin, shrivelling markedly and often mostly deciduous. Spores regular.

Cytology: Diploid sexual (W. Himalaya: Gibby (1985). E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimen, *D. S. Loyal*, August 1954–1955 (PAN 860!, 862–866!). Loyal in Mehra & Khullar (1980)).

Ecology: A plant of high-level meadows, often in the open, otherwise between bushes, growing on the ground, from *c.* 3100–4500 m alt.

Range: N. Pakistan (east of the Indus); India (W. Himalaya; E. Himalaya in Sikkim and N. Assam); Nepal; Bhutan; S. and SE. Tibet; ? N. Burma; China (Yunnan, Szechuan). A Sino-Himalayan subspecies of the Tibetan sort, widespread throughout the Himalaya.

Range in the Indian subcontinent: **20** Ghora Naka, Bhonja, Kagan, 23 July 1897, *Inayat & J. F. Duthie* 20793 (DD!, K!); **21** Muzzafarabad, 17 July 1899, *J. F. Duthie* 23201 (K!); **24** Above Khilanmarg, Mt Apharwat, above Gulmarg, Pir Panjal range, 3200 m, 24 August 1977, *C. R. Fraser-Jenkins* 6485, 6486 (BM!), 6487, 6488 (Herb. T. Reichstein, Basel!), 6490 (PE!); **25** Donari Pass, 11,000 ft (3340 m), September 1891, *J. C. McDonell* 19 (DD!, K!, P!); **26** Upper Liddar East, 12,000 ft (3640 m), 19 September 1889, *E. W. Trotter* (BM!); **32** Chamba, 11–12,000 ft (3340–3640 m), 1898, *J. Marten* 43 (K!); **35** Dibibokri Nal, Kulu district, 12,900 ft (3910 m), 13 July 1952, *E. Schelpe* 3512 (BM!); **36** Lahul, Khoksar, 13,000 ft (3940 m), 27 July 1930, *W. N. Koelz* 759 (MICH!, PE!); **37** Ghor Jubal, Simla, 11,500 ft (3490 m), September 1878, *H. Collett* 5420 (K!); **41** Kidar Kanta Mountain, 1879, *Major Herschell* (DD!, RAW!); **43** Garhwal, Valley of Flowers, 3800 m, 8 October 1962, *U. C. Bhattacharyya* 24398 (BSD!); **45** Near Pindari Glacier, 10–11,000 ft (3040–3340 m), 11 September 1891, *E. W. Trotter* 878 (BM!, RAW!); **48** Ralam Valley, 12–13,000 ft (3640–3940 m), 23 August 1884, *J. F. Duthie* 3665 (BM!, DD!); **49** Bajang to Thogundanda, 27 August 1972, *M. S. Bista & D. P. Joshi* 740, 742 (KATH!); **51** Deoli Patan, south-east of Jumla, 12,500 ft (3790 m), 5 September 1952, *O. Polunin, W. R. Sykes & L. H. J. Williams* 3191 (BM!, E!); **53** Near Phagune Dhuri, 13,000 ft (3940 m), 12 October 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 9002 (BM!, E!); **54** Toketey, 12–14,000 ft (3640–4240 m), 21 February 1931, *Capt. Lall Dhwoj* 572 (BM!, E!); **55** Lamjung Himal, 13,500 ft (4090 m), 14 July 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 6342 (BM!, E!); **57** Chilime Kharka, 14,500–15,000 ft (4390–4540 m), July 1949, *O. Polunin* 1254A (BM!); **59** Dupuk, Helumbu, 12,700 ft (3850 m), 25–26 July 1974, *R. L. Fleming* 1805 (KATH!, MICH!); **60** Ribouk, Barun Khola, 12,600 ft (3820 m), 25 July 1973, *H. Emery, E. W. Cronin & Foster*

Fig. 30 *Dryopteris barbigera* subsp. *barbigera*. India, Kashmir, north-east of Pahlgam, Chatponsal, Bajipath, 21 August 1978, *C. R. Fraser-Jenkins* 7494 (BM). Scale line = 1 cm.

F.038, F.1251 (BM!, KATH!); **62** Arun valley, Thudam, east of Chyamtang, 12,500 ft (3790 m), 16 July 1956, *J. D. A. Stainton* 1020 (BM!); **65** Above Changu, Chola Range, 12,000 ft (3640 m), 8 July 1910, [*Kari*] '*Collecteur de Darjeeling*' 3212 (BM!); **67** Dam Thang to Charitang, 10,000–12,000 ft (3040–3640 m), August 1938, *B. J. Gould* 1386 (K!); **71** Narim Thang, Kurted, 13,000 ft (3940 m), 2 August 1915, *R. E. Cooper* 4282 (BM!); **74** Mila, Tawang, *P. Chandra* 80407 (LWG!).

Notes: Ching (1938) quoted from Hooker when he mentioned a collection of Wallich's (No. 344), mixed with *Athyrium wallichianum*, with the word 'type' in brackets after it. However, this

cannot be taken as the designation of a lectotype since there is no indication as to which specimen was intended or of the herbarium in which it was located. Indeed there is now no such specimen in K-W, BM, etc. A lectotype is therefore designated here.

Dryopteris barbigera subsp. *barbigera* has sometimes been confused by earlier collectors with *Polystichum longipaleatum* Christ (= *P. setosum* (Wallich ex C. B. Clarke) Christ, nom. illeg., *P. setosum* Schott, nom. nud.) as both are very scaly and, in the young state, the lamina of both is covered with very narrow, hair-like scales. However, the segment shape is completely different. It is also confused occasionally with *Athyrium wallichianum* Ching (= *Dryopteris brunoniana* (Wallich ex Mett.) Kuntze), but the latter has less divided pinnae with shorter pinnules and markedly black stems. The report by Khullar in Löve (1970) and by Mehra & Khullar (1980) of a hexaploid *D. barbigera* refers to *Athyrium wallichianum* (voucher specimen from Kashmir, *S. P. Khullar* 43 (PAN 5487!)).

28b. Dryopteris barbigera subsp. **komarovii** (Kossinsky) Fraser-Jenkins, **comb. nov.** **Fig. 31**

Dryopteris komarovii Kossinsky in *Bot. Mater. Gerb. glavn. bot. Sada* **2**: 1 (1921). Type: U.S.S.R., Tienshan, Chschartob, 20 August 1892, *V. L. Komarov* (LE! – holotype).

Dryopteris subbarbigera Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 260, fig. 62, 6 (1983). Type: Tibet, Dengqen (Kyangngön), *C. Y. Wu et al.* 4946 (PE! – holotype).

Fronds smaller than in subsp. *barbigera* (up to *c.* 45 cm long), arising from a much-branched, tufted rhizome, thus forming a clump. Stipe usually somewhat short, *c.* ⅓ the length of the lamina, with paler scales. Lamina noticeably more narrowly lanceolate (up to *c.* 15 cm wide), with a more acute and gradually tapering apex, and more blue-green above; pinnae more separate and more upright, and not tapering so abruptly at their apices; pinnules shorter, more shallowly lobed and often slightly developed on the basiscopic side of the pinna towards the bases of the lowest few pinnae. Spores regular.

Cytology: Diploid sexual (E. Himalaya: Loyal in Mehra (1961), sub *D. barbigera* part. Mehra & Loyal (1965), sub *D. barbigera* part, voucher specimen, *D. S. Loyal*, July 1958 (PAN 2503–2506!)).

Ecology: A plant of somewhat dry, high-level, open rocky places, growing between rocks, beside boulders or in rock crevices, from *c.* 3100–4800 m alt.

Range: U.S.S.R. (Pamirs, Tien Shan); N. Pakistan (west and east of the Indus); India (W. Himalaya; E. Himalaya in Sikkim and N. Assam); Nepal; Bhutan; NE., E., SE. and S. Tibet; N. Burma; China (Yunnan, Szechuan, Tsinghai, Shansi, Kansu); Taiwan. A Sino-Himalayan subspecies of the Tibetan sort, but spreading further west than other taxa of this sort (and also in Taiwan), due to its ability to survive in cold, dry, high-altitude regions, and reaching the European-type flora in the Tien Shan, the only Himalayan fern to do so.

Range in the Indian subcontinent: **10** Shend Toi, 9500–10,000 ft (2890–3040 m), 28 August 1879, *J. E. T. Aitchison* 1009, 790 (DD!, K!); **15** Naltar, Gilgit, 12,000 ft (3640 m), 20 July 1954, *R. R. Stewart* 26485 (BM!); **20** Shale cliff above Lake Saif-ul-Malluk, 5 km above Naran, upper Kunhar (Kagan) valley, 3100 m, 10 August 1977, *C. R. Fraser-Jenkins* 6374, 6375 (BM!); **24** Fras Nag, Pir Panjal, *R. R. Stewart* 23238 (PE!); **25** Kishenganga valley and road to Nanga Parbat, Kamri Pass, 18 August 1939, *R. R. Stewart* (RAW!) and *R. R. & I. D. Stewart* 18115 (E!); **26** On the way to Kolahoi from Pahlgam, 12,000 ft (3640 m), July–August 1927, *F. G. Dickason* 1420 (MICH!); **29** 1 km west of Meenamarg, east side of Zogila Pass, Sonamarg to Kargil, north-east of Srinagar, 3250 m, 26 August 1977, *C. R. Fraser-Jenkins* 6513, 6514 (BM!), 6517 (PE!, Herb. T. Reichstein, Basel!); **32** Sural valley, Pangi, 12,500 ft (3790 m), 18 July 1899, *Harsukh & J. F. Duthie* 23368 (DD!, K!); **36** Lahul, Shipting Nullah, 11,000 ft (3340 m), 4 August 1930, *W. N. Koelz* 944, 945 (MICH!); **41** Under Bandarpunch, 13–14,000 ft (3940–4240 m), 25 August 1883, *J. F. Duthie* (DD!); **45** Peak above Gunji, 15,000 ft (4540 m), *W. N. Koelz* 21224 (PE!); **49** Opposite Budhi village, 10–11,000 ft (3040–3340 m), 18 July 1886, *J. F. Duthie* 6284 (K!); **51** Dojam Khola, 16,000 ft (4840 m), 5 July 1952, *O. Polunin, W. R. Sykes & L. H. J. Williams* 1477 (BM!); **54** Longpoghyun Khola, Nilgiri N. face, 13,000 ft (3940 m), 18 July 1977, *G. Miehe* B.215 (BM!); **57** Larkya Bazar, 12,500 ft (3790 m), 6 July 1953, *P. C. Gardner* 1155, 1157 (BM!); **59** Cha Lungpa, 15,000 ft (4540 m), 29 July 1977, *G. Miehe* B.371 (BM!); **65** Thangu, July 1958, *D. S. Loyal* (PAN 2503–2506!); **68** Padima Tso, near Thampe La, 15,000 ft (4540 m), 23 August 1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 17187 (BM!, E!).

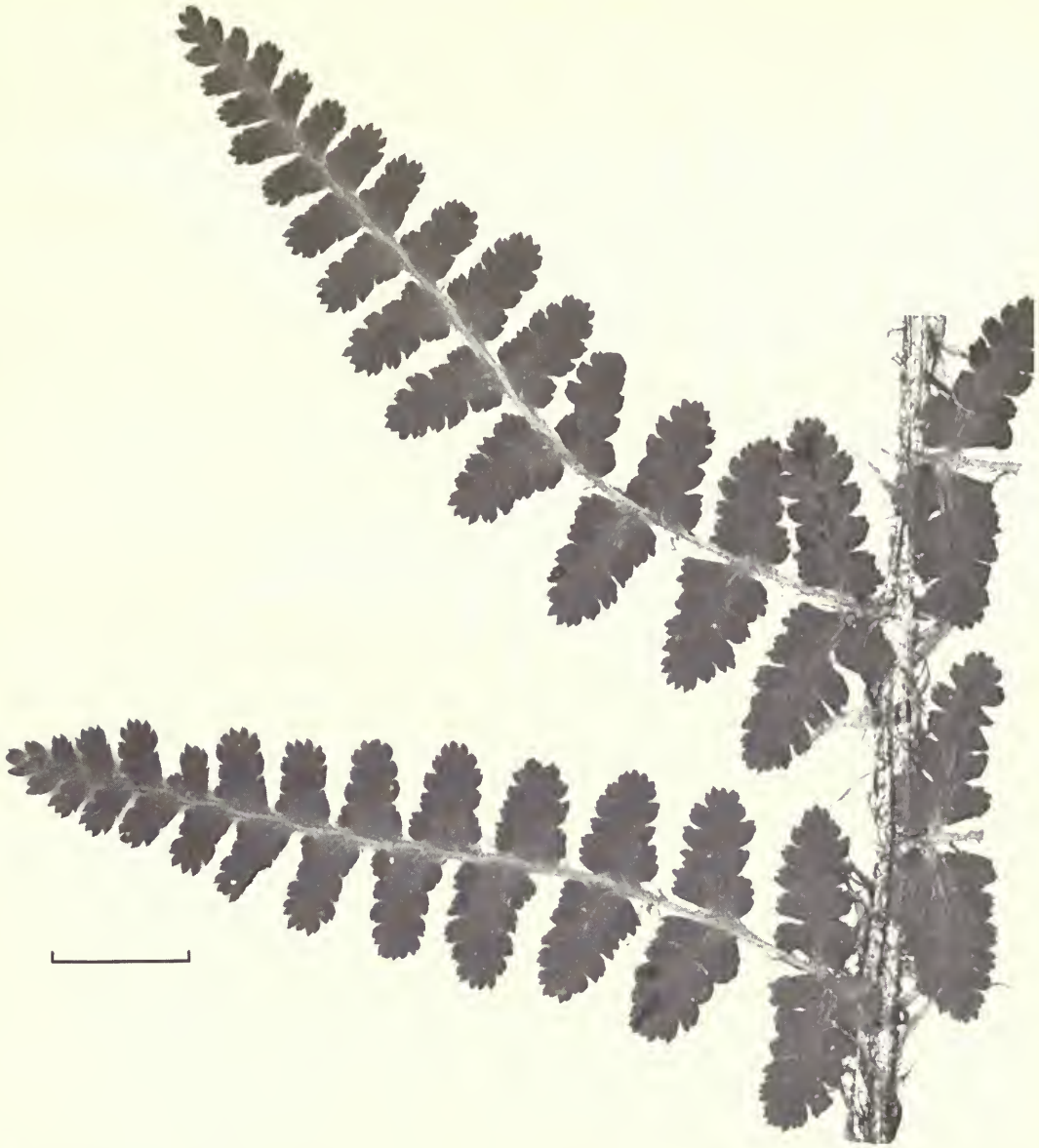

Fig. 31 *Dryopteris barbigera* subsp. *komarovii*. India, Baltistan, Zojila Pass, Meenamarg, 17 August 1978, *C. R. Fraser-Jenkins* 7450 (BM). Scale line = 1 cm.

Notes: Reported from the Indo-Himalaya for the first time here, this subspecies appears to be a rock-growing, dwarf ecotype of *Dryopteris barbigera*, more or less separated from subsp. *barbigera* but obviously closely related to it and not fully separable as a species. Small plants of subsp. *barbigera* can be difficult to distinguish from it, but usually have longer, narrower pinnules and a more abruptly ending frond apex with less upright pinnae. Some plants occur which are intermediate between the two subspecies. Subsp. *komarovii* is rather frequently confused with *Athyrium wallichianum* Ching (see under subsp. *barbigera*). In the eastern part of its range (SE. Tibet, Yunnan, and slightly so in Bhutan) occasional populations show a tendency towards somewhat dark or dark-centred scales, a feature shared by several other high-level species of *Dryopteris* and *Polystichum* of the Tibetan type in the eastern part of their range.

There is, however, another distinct species from SE. Tibet, *D. tingiensis* Ching & S. K. Wu ex Fraser-Jenkins, which has dark scales and the larger, irregular spores of an apomict. It should not be confused with *D. acuto-dentata* Ching.

Section 5. Remotae Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 192 (1986).

29. Dryopteris blanfordii (C. Hope) C. Chr.

Index filic.: 254 (1905). – *Nephrodium blanfordii* C. Hope in *J. Bombay nat. Hist. Soc.* **12**: 624, pl. 11 (1899). Type: India, hill above Narkanda, 9500 ft, 20 July 1885, *H.F.B*[*lanford*], Herb. C. W. W. Hope (BM! – lectotype, selected here; K! – isolectotype).

Misapplied names: Lastrea filix-mas var. *remota* sensu Beddome (1870, etc.); *Nephrodium remotum* sensu C. B. Clarke (1880); *Lastrea remota* sensu Blanf. (1888, etc.).

Dryopteris blanfordii is divided here into two closely related subspecies which occupy different parts of the range of this bicentric species. They are presumed to have arisen through geographical isolation as the species appears to be absent from Nepal but is present in the west Himalaya, SE. Tibet, and SW. China. In both the western and eastern populations some specimens match very closely some of those from the other population, but it is normally possible to distinguish them. The relationship between the subspecies has not been investigated and requires study.

29a. Dryopteris blanfordii subsp. **blanfordii** **Fig. 32**

Dryopteris mehrae Khullar in Mehra & Khullar, *Res. Bull. Panjab Univ.* II, **25** (3–4): 150, fig. 16E (1980 ['1974']), nom. nud. (Art. 32.1). Specimens in PAN!

Fronds large (up to *c.* 90 cm long). Stipe of medium-length, *c.* ⅓ to ½ the length of the lamina, the base densely clothed with ovate to markedly ovate-lanceolate, thin, glossy, slightly crinkled scales, varying in colour from smokey darkish brown (rarely paler in occasional, usually young, plants) to, more normally, very dark castaneous-blackish-brown or a coal-like black, becoming somewhat smaller, but remaining dense and ovate-lanceolate further up the stipe and on the lower rachis, becoming narrower and mixed with hair-like, pale- to mid-brown scales further up the rachis. Lamina twice pinnate, becoming a third time deeply pinnatifid below in large plants, lanceolate to somewhat narrowly lanceolate (up to *c.* 35 cm wide), slightly tapered below to a somewhat truncate base, bearing many (up to *c.* 28 pairs) contiguous or slightly distant pinnae; pinnae ± linear-lanceolate, becoming ± triangular-lanceolate below, herbaceous, mid- or slightly darkish green and slightly glossy above, bearing scattered very small, hair-like, pale scales, or fibrillae, mainly on the lower surface of the costae, bearing many (up to *c.* 20 pairs) medium-sized pinnules; pinnules somewhat long, ± narrow, lanceolate, stalked at the very bases of the pinnae, but narrowly attached further up and becoming widely attached to the pinna-costa about half way up the pinna, varying from nearly unlobed in small plants and in the upper parts of the lamina to very deeply lobed, especially below, lower lobes in each pinnule somewhat narrow, slightly distant, rectangular with truncate apices, each bearing an acute tooth on the corner nearest the pinnule apex, but upper lobes (nearer the pinnule-apex) becoming pointed and ending in a single, acute tooth, pinnule-apices ± acutely pointed (though more rounded-truncate in small plants), bearing acute teeth around them, pinnules on the basiscopic side of the lowest few pairs of pinnae usually developed and longer than those on the acroscopic side. Sori ± small, not crowded, in two rows, one on each side midway between the centre and margins of the pinnule, though the larger basal lobes of lower pinnae may themselves bear two short rows of about two sori each, indusiate; indusia slightly curved down at the edges, ± thick, becoming brown, shrivelling considerably, lifting and mostly deciduous. Spores irregular, with fully formed and abortive spores.

Cytology: Triploid apomict (W. Himalaya: Mehra & Khullar in Löve (1970), voucher specimens, *S. P. Khullar*, 16 July 1965 (PAN 5373!) and *S. P. Khullar* 78, July 1966 (PAN 5435!).

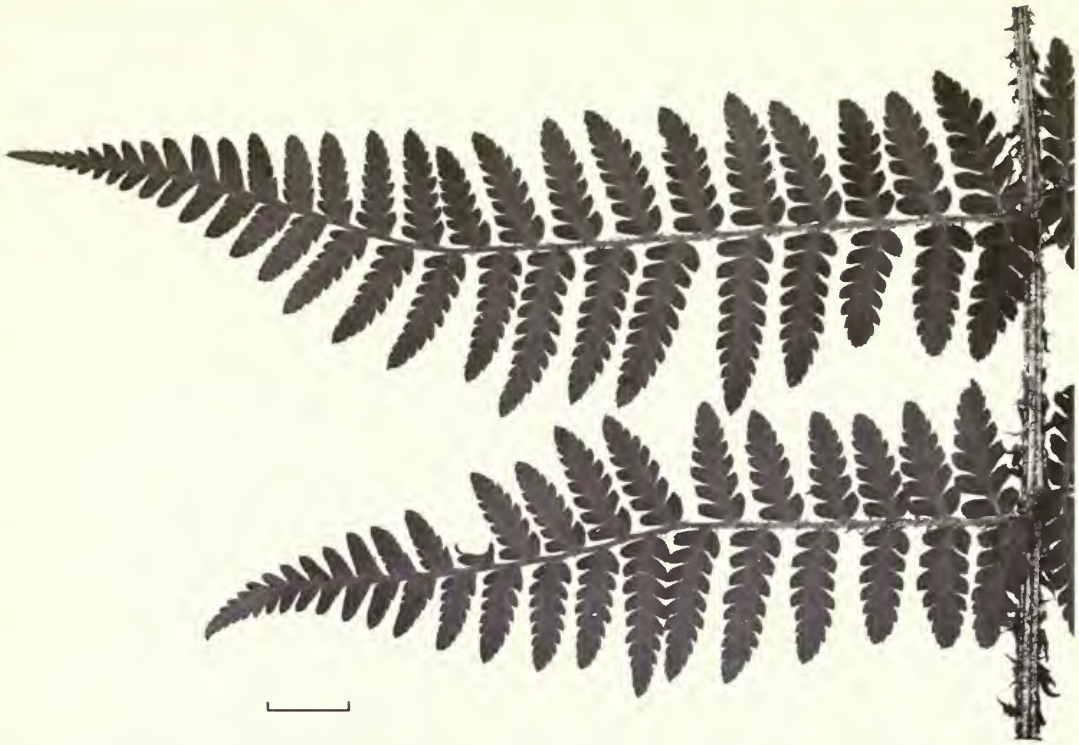

Fig. 32 *Dryopteris blanfordii* subsp. *blanfordii*. India, Kashmir, Sonamarg to Ganderbal, Gund, 15 August 1978, *C. R. Fraser-Jenkins* 7409 (BM). Scale line = 1 cm.

Mehra & Khullar (1980), voucher specimens, *S. P. Khullar* 16 and 78 (as in Mehra & Khullar in Löve (1970)) and *S. P. Khullar* 11, July 1965 (K!, PAN 6072!). Gibby (1985)).

Ecology: A subspecies of the mid- and upper-level forest zone, but also extending into the alpine meadow zone, growing on the ground in forests or between rocks, from *c.* 1700–3600 m alt.

Range: NE. Afghanistan; Pakistan (Himalaya west and east of the Indus); India (W. Himalaya). A Sino-Himalayan subspecies of the west Himalayan sort. As with several other west Himalayan taxa there is a very closely related taxon behind the Himalayan line in SE. Tibet and SW. China. This is separated here as subsp. *nigrosquamosa*, and is apparently disjunct from the western subsp. *blanfordii*.

Range in the Indian subcontinent: **2** 'Berg N.N.O. Kamdesch', 2800 m, *A. Gilli* 24 (W!); **10** Kurram valley, Shend Toi, 9–10,000 ft (2740–3040 m), 10 July 1879, *J. E. T. Aitchison* 790 (DD!, K!); **14** Among boulders, *c.* 5 km above Kolaloi, north of Saidu Sharif, mid Swat valley, 1700 m, 1 October 1978, *C. R. Fraser-Jenkins* 7937 (BM!); **19** Burzil Pass, 1 August 1946, *R. R. Stewart* 22063a (RAW!); **20** 3 km below Naran, above Kagan, upper Kunhar (Kagan) valley, 2300 m, 10 August 1977, *C. R. Fraser-Jenkins* 6404, 6408, 6411 (BM!), 6408, 6412 (PE!); **21** Keran, Kishenganga valley and road to Nanga Parbat, *c.* 6000 ft (1830 m), 15 July 1939, *R. R. & I. D. Stewart* 17711A (RAW!); **24** North-east slope of Mt Apharwat, above Gulmarg, Pir Panjal range, west of Srinagar, 2600 m, 24 August 1977, *C. R. Fraser-Jenkins* 6470–6472 (BM!), 6470, 6472, 6479 (PE!), 6479 (Herb. T. Reichstein, Basel!); **25** Koragbal, Kishenganga watershed, 9000 ft (2740 m), 11 July 1946, *R. R. Stewart* 22585 (K!, PE!); **26** East side of upper Chatponsal Nullah, near Bajipath, north-east of Pahlgam, Liddar valley, 3400 m, 21 August 1978, *C. R. Fraser-Jenkins* 7514, 7515 (BM!); **27** Banihal Pass, 8–9000 ft (2440–2740 m), 1 July 1931, *R. R. Stewart* 12138 (PE!, RAW!); **28** Sdeeling, Basahr, 10,000 ft (3040 m), 2 July 1840, *J. H. Lace* 348 (DD!, K!); **29** Nullah *c.* 2 km above Chanigund, west of Kargil, Baltistan, 3250 m, 18 August 1978, *C. R. Fraser-Jenkins* 7464 (BM!); **32** 15 km below Satrundi, north of Tissa, north of Ravi valley, north-west of Chamba, 2700 m, 10 September 1978, *C. R.*

Fraser-Jenkins 7841, 7842 (BM!, H!); **35** 5 km above Kothi, 18 km above Manali, south side of Rohtang Pass, north of Mandi, north of Simla, 2700 m, 2 September 1977, *C. R. Fraser-Jenkins* 6810, 6827 (BM!); **36** Lahul, Shipting Nullah, 11,000 ft (3340 m), 2 August 1930, *W. N. Koelz* 903 (MICH!, PE!); **37** North side of Mt Hattu, just below top, south-east of Narkanda, north-east of Simla, 3000 m, 6 September 1977, *C. R. Fraser-Jenkins* 7032 (BM!), 7030, 7031 (PE!), 7030 (Herb. T. Reichstein, Basel!); **39** Jaunsar, Mundali, 8000 ft (2440 m), May 1891, *J. S. Gamble* 23748 (K!); **41** Phulaldaru in Nila valley, Tihri Garhwal, 11–12,000 ft (3340–3640 m), 23 June 1883, *J. F. Duthie* 125 (BM!, K!); **42** Balcha, Tehri Garhwal, 8500 ft (2590 m), May 1898, *J. S. Gamble* 26670 (P!), and Deota, Tehri Garhwal, 8000 ft (2440 m), May 1891, *J. S. Gamble* 22993 (K!); **48** Kumaon, *R. Strachey & J. E. Winterbottom* 13 (K!).

Notes: Dryopteris blanfordii was confused with the European species, *D. remota* (A. Braun ex Doell) Druce, until Hope (1899) recognised it as distinct. It is a very variable species and small specimens from drier places, particularly from the western part of its range, have almost unlobed pinnules and narrower lamina bases. They thus approach *D. pulcherrima*, as was noticed by Stewart (1945), who thought such specimens near to *D. rosthornii*, a name he misapplied to *D. pulcherrima*. Khullar in Mehra & Khullar (1980) named such plants *D. mehrae*. But even when small it can be easily distinguished from *D. pulcherrima* by its wider scales and more lobed lowest pinnules. Medium-sized plants can appear similar to *D. filix-mas*, but have darker scales and more lobed lower pinnules. Large, well-developed specimens from dense forest areas have long, deeply lobed pinnules and can be difficult to separate from *D. stewartii*, though they have darker scales, thicker indusia and sori nearer to the centres of the pinnules. Occasional plants have paler or mid-brown scales, though they generally have a somewhat smokey appearance in such cases.

One population of *D. blanfordii* (from Gund, Sind valley, Kashmir, *C. R. Fraser-Jenkins* 6594, 6595 (BM!), 6594, 6596, 6597 (PE!), 6596 (Herb. T. Reichstein, Basel!), and *C. R. Fraser-Jenkins* 7404–7406 (BM!, H!), 7403 (PE!), occurring with normal *D. blanfordii*, differs significantly from it in having russet-brown fibrillae on the rachis combined with more shallowly lobed pinnules, but a wide lamina base. It thus approaches *D. yigongensis*, but nevertheless has the characteristic wide, thin stipe-base scales of *D. blanfordii*. It, too, is triploid (Gibby (1985), sub *D. blanfordii* subsp. *blanfordii* part) and shows no differences in phloroglucides from *D. blanfordii* (Widén et al., in prep.), though there is a degree of chemical variation within *D. blanfordii* itself. However, it may be a new species, but is undergoing further study and comparison with other related or similar species and, as yet, it is not possible to decide whether it is really distinct from *D. blanfordii*. This taxon was not recognised by Fraser-Jenkins (1986).

D. blanfordii is absent from the central and eastern parts of the Indo-Himalaya, though a specimen of Loyal's (Sandakphu, Darjeeling, 12,000 ft, August 1955 (PAN!)) was misidentified by Alston as this species, in error for *Dryopsis nidus* (C. B. Clarke) Holttum & Edwardes. It appears likely that *D. blanfordii* could be derived from *D. pulcherrima* and either *D. ramosa* or *D. goeringiana* (Kunze) Koidz., but there is as yet no evidence, beyond its morphology and cytology, to support this, and further research is required.

29b. **Dryopteris blanfordii** subsp. **nigrosquamosa** (Ching) Fraser-Jenkins, **comb. nov.**

Dryopteris nigrosquamosa Ching in *Bull. Fan meml Inst. Biol.* **2**: 194 (1931). Type: China, Kansu [SE., Cheu-menn, Hoei Hsien], 7 May 1919, *Licent* 5208 p.p. (PE! – holotype)

Dryopteris gushaingensis Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 269, fig. 64, 6–8 (1983). Type: Tibet, Pome, Kooshiang, 29° 55°N, 95° 30′E, 2880 m, 10 June 1965, *Ying, J.-S.* 0207 (PE! – holotype; PE! – isotypes).

Dryopteris gongboensis Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 269, fig. 61, 3–5 (1983). Type: SE. Tibet, Kongbo, valley above Sang, 29° 33′N, 94° 42′E, 10,500 ft, 26 June 1938, *F. Ludlow, G. Sherriff & G. Taylor* 4993 (PE! – holotype; BM!, MICH! – isotypes).

Differs from subsp. *blanfordii* only in its tendency to have fuscous-brown scales in a slightly higher proportion of plants, and in having a thinner lamina with a slightly more delicate texture, especially in smaller plants; the pinnule apices in small plants are occasionally slightly less pointed than in subsp. *blanfordii*. However, many plants match almost exactly.

Cytology: Unknown.

Range: SE. Tibet and W. China (Yunnan, Szechuan, Kansu, Shensi).

Notes: Ching's *Dryopteris gushaingensis* merely represents smaller, younger plants of the subspecies. It is of significance that two large specimens of *D. blanfordii* subsp. *blanfordii* from the west Himalaya (*C. R. Fraser-Jenkins* 7415 (BM!) and *J. Marten* 42 (BM!)) were identified by Ching in 1981 as his *D. gongboensis*, which emphasises the close similarity between the two subspecies. When Ching described *D. gongboensis*, his concept of Indian *D. blanfordii* was generally of narrower, less dissect plants, which is why he considered larger plants to be distinct. Cytological and phytochemical studies of subsp. *nigrosquamosa* are needed to cast further light on its relationship to subsp. *blanfordii.*

Section 6. Pallidae Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 192 (1986).

30. Dryopteris sublacera Christ **Fig. 33**

in Lecomte, *Not. syst.* **1**: 43 (1909). – *Nephrodium sublacerum* (Christ) Hand.-Mazz., *Symb. sin.* **6**: 24 (1929). Type: China, Yunnan, Yunnan Sen, Tchong Chan, sous bois – vallons, 4 October 1905, *F. Ducloux* 3347 (P! – lectotype, selected here; P! – isolectotype).

Dryopteris blepharolepis C. Chr. in A. Léveillé, *Cat. pl. Yun-Nan*: 103 (1916). Type: China, rivières des torrents, vallées derrière Tong-Tchouan, 2500–2600 m, October 1912, *E. E. Maire* (E! – lectotype, selected here; BM!, E!, P! – isolectotypes).

Dryopteris juxtaposita forma *mutica* A. Léveillé, *Cat. pl. Yun-Nan*: 104 (1916). Type: China, Yunnan, derrière Tchong-Tchouan, 2600 m, *Maire*, Herb. A. Léveillé (P! – holotype).

Dryopteris schneideriana Hand.-Mazz. in *Anz. Akad. Wiss. Wien* 1922: 49 (1922). Type: China, 'Prov. Setschwan austro-occ.: Inter pagos Tungan et Dschanggwandschung', Huili, *c.* 2000 m, 22 March 1914, *C. Schneider* 127 (W! – lectotype, selected here; BM! – isolectotype).

Dryopteris minjiangensis H. S. Kung in *Acta bot. yunnan.* **4** (4): 341 (1982). Type: China, Sichuan, Li Xian, *D. P. He* 4483 (SZ – holotype, only photograph seen).

Dryopteris nyingchiensis Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 262 (1983). Type: Tibet, Lingtze, 3100 m, 4 August 1965, *Chang, Y.-T.*, Medical Expedition 1131 [?1311] (PE! – holotype; PE! – isotype).

Misapplied name: Aspidium lacerum var. *obtusum* Christ (1909).

Fronds small to medium-sized (up to *c.* 70 cm long). Stipe medium to long, *c.* ⅓ to ½ the length of the lamina, the base densely clothed with large, lanceolate, mid-brown scales, often with very dark basal regions, which become smaller and narrowly lanceolate, but remain ± dense further up the stipe and on the rachis, where they become very narrow, varying from mid-brown to dark brown or ± black, usually with paler apices, scales all with minutely toothed edges, partly deciduous, leaving small murications on the stipe and rachis where they were attached. Lamina twice pinnate, elongated triangular-lanceolate (up to *c.* 18 cm wide), not tapered below, bearing up to *c.* 20 pairs of ± contiguous pinnae; pinnae narrowly triangular-lanceolate, herbaceous, matt and mid-green above, bearing rather numerous small, scattered, very narrow, mid-brown scales on the under-side of the costae towards their bases, pinnae bearing up to *c.* 15 pairs of somewhat small pinnules; pinnules short, longer than broad, stalked or with a narrow point of attachment to the pinna-costa except in the upper parts of the pinnae where they become widely attached, somewhat crowded, parallel-sided, ranging from unlobed to somewhat shallowly lobed, with ± rectangular lobes with rounded-truncate apices, the basal pair of lobes often somewhat enlarged, lobes without teeth or occasionally bearing a few insignificant, shallow teeth, pinnule-apices ranging from rounded to obtusely pointed and bearing ± small, rather short, acute teeth around them. Sori somewhat large, not crowded, in two rows, one on each side midway between the centre and margins of the pinnules, indusiate; indusia curved down at the edges, somewhat thick, becoming light- to mid-brown, shrivelling very slightly and lifting slightly, mostly persistent. Spores irregular, with fully formed and abortive spores.

Cytology: Triploid apomict (W. Himalaya: Gibby (1985). China (Yunnan): Gibby (1985)).

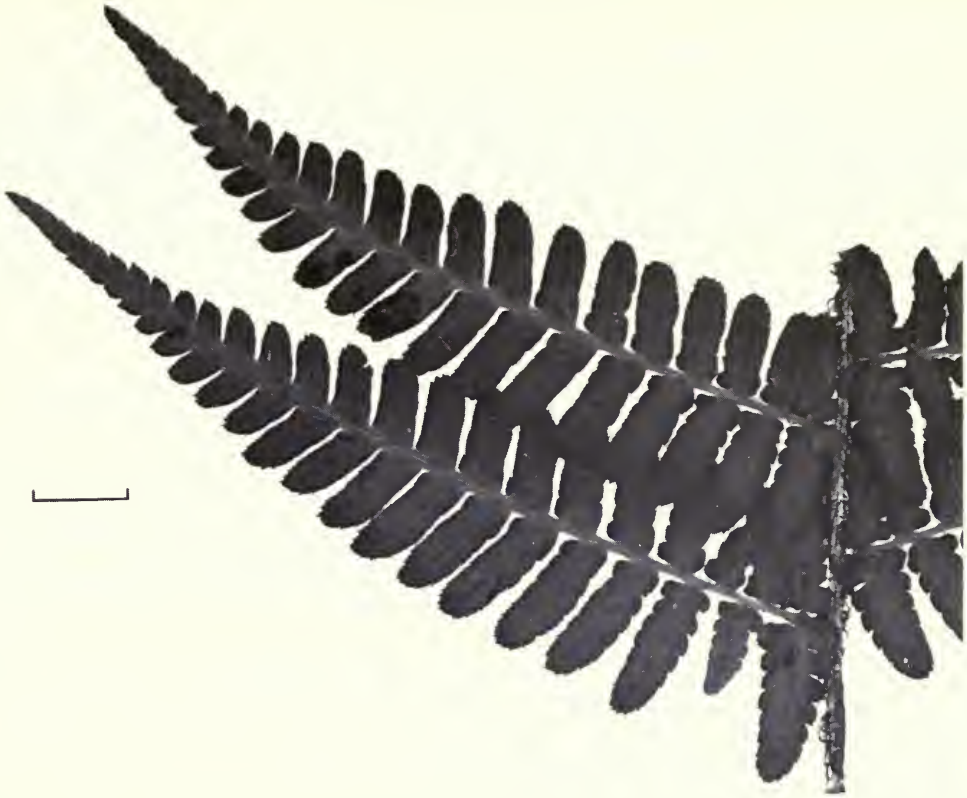

Fig. 33 *Dryopteris sublacera*. India, Himachal Pradesh, Simla, Narkanda, Mt Hattu, 26 August 1978, *C. R. Fraser-Jenkins* 7605 (FR). Scale line = 1 cm.

Ecology: A species of mid- to upper-level forests, growing on the ground, from *c.* 2200–3400 m alt.

Range: India (eastern part of the W. Himalaya; E. Himalaya in N. Assam and ?Sikkim); Nepal; Bhutan; SE. Tibet; China (Yunnan, Szechuan, Kweichow, Shensi); Taiwan. A Sino-Himalayan species of the widespread sort.

Range in the Indian subcontinent: **32** Barmaur, Ravi valley, *J. C. McDonell* 53 (K!); **35** 5 km above Kothi, 18 km above Manali, south side of Rohtang Pass, north of Mandi, north of Simla, 2700 m, 2 September 1977, *C. R. Fraser-Jenkins* 6838–6841 (BM!), 6848 (PE!); **37** North-east side of Mt Hattu below top, near Narkanda, north-east of Simla, 3000 m, 26 August 1978, *C. R. Fraser-Jenkins* 7596, 7599, 7600, 7601 (BM!), 7605 (FR!), 7597, 7598, 7600, 7602, 7604, 7606, 7618, 7619, 7631 (H!); **39** Chakrata, 7000 ft (2130 m), July 1902, *P. W. Mackinnon* (CAL!); **42** About 4 km above Trijugi Naryan on path to Mongu, west of Sonprayag, north of Rudraprayag, west side of Mandakini valley, *c.* 2700 m, 24 October 1978, *C. R. Fraser-Jenkins* 8314, 8316 (BM!), 8314, 8315 (H!); **43** Badrinath, 1982, *S. P. Khullar* 5212 (PAN!); **45** Pindhar gorge, above Dwali, 8500 ft (2590 m), 10 September 1891, *E. W. Trotter* 847 (RAW!); **53** Tarakot, 82° 45′E, 28° 57′N, 3200 m, 30 June 1973, *S. Einarsson, L. Skärby & B. Wetterhall* 1352, 1356 (BM!); **54** 5 km above Tukche, 11,500 ft (3490 m), 1 December 1949, *R. L. Fleming* 888 part (BM!, DD!, RAW!), 890 (MICH!); **55** Chhokang, Dhading, 10,000 ft (3040 m), 20 May 1973, *D. Lichter* 52 (KATH!); **57** Shiar Khola, west of Thumje, 9500 ft (2890 m), 27 June 1953, *P. C. Gardner* 928 (BM!), and 8000 ft (2440 m), 20 June 1953, *P. C. Gardner* 806 (BM!); **59** Langtang, distr. Rasuwa, Khazing to Serpagaon, 2300–2700 m, 2 October 1977, *V. L. Gurung & party* 77/683 (KATH!); **60** Rive gauche de la Smja Khosi, près de la Bhoti Khosi, 2800 m, 11 May 1952, *A. Zimmermann* 488 (BM!); **62** Upper Mewa Valley, 9000 ft (2740 m), *R. L. Fleming* 2132 (K!); **66** Sashima, above Chumbi, 10,000 ft (3040 m), 12 September 1912, *R. Lepcha* 570 (E!); **67** Dotanang (2500 m) to Tabab (2350 m) to Thimphu (2250 m), 28 May 1967, *H. Hara* 1362 (E!); **69**

Bumthang Tang, near Bumthang, 10,000 ft (3040 m), 13 April 1949, *F. Ludlow, G. Sherriff & J. H. Hicks* 18693 (BM!).

Notes: Dryopteris sublacera has been overlooked in the Indo-Himalaya and is reported from the region for the first time here. It is a somewhat variable species, some plants having wider and coarser fronds and larger segments, though these can revert to normal in cultivation. It also varies in the degree of lobing and in the scale colour which is predominantly darker in Indo-Himalayan plants, but either dark (or dark-based) or brown in Chinese and Tibetan plants.

In his original description, Christ reduced *Aspidium lacerum* var. *obtusum* to synonymy under *Dryopteris sublacera*, citing one of the syntypes of var. *obtusum* as a syntype of *D. sublacera*. However, this was an error as *Aspidium lacerum* var. *obtusum* is not the same taxon as *D. sublacera*, but belongs to the species *D. peninsulae* Kitagawa, which is known from China, Korea, and Taiwan. It is clear from Christ's description of *D. sublacera* (abundant scales on the rachis and costae, and well-lobed pinnules) that he was describing the present species and not *D. peninsulae*. For the sake of clarity a lectotype of *Aspidium lacerum* var. *obtusum* is also chosen here, all of the specimens cited in the protologue (Christ in *Mém. Soc. bot. Fr.* **1** (1): 39 (1905)) being *D. peninsulae*. The lectotype is as follows: China, Nan-To and mountains to northward, February 1887, *A. Henry* 2118 (P!).

Dryopteris peninsulae (= *D. neolacera* Ching and *D. lacera* var. *chinensis* Ching) is very close to *D. lacera* (Thunb.) Kuntze of east China (Honan, Kiangsi, Kiangsu, Chekiang, Anwhei), Japan, Cheju Do, and Korea, differing only in having less contracted fertile parts of the frond, slightly more obtuse pinnule apices and fewer, paler stipe and rachis scales. However, intermediates between the two occur in north-east China and it is very probable that *D. peninsulae* represents no more than a geographical subspecies of *D. lacera* (subsp. *peninsulae* (Kitagawa) Kitagawa), though it was treated as a species by Fraser-Jenkins (1986).

31. Dryopteris odontoloma (Beddome) C. Chr. **Fig. 34**

in *Acta Horti gothoburg.* **1**: 59 (1924). – *Lastrea odontoloma* Beddome, *Ferns S. India*: 39, pl. 114 (1864). – *Nephrodium filix-mas* var. *odontoloma* (Beddome) Baker in Hook. & Baker, *Syn. fil. ed. 2*: 498 (1874). – *Lastrea filix-mas* var. *odontoloma* (Beddome) Beddome, *Suppl. ferns S. Ind.*: 17 (1876). – *Nephrodium odontoloma* (Beddome) C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 521 (1880). Type: India, Nilgiris, *Beddome* (K! – lectotype, selected here).

Fronds small to medium-sized (up to *c.* 65 cm long). Stipe long, *c.* ⅓–½ the length of the lamina, the base densely clothed with large, lanceolate, thick, glossy scales, varying in colour from very dark castaneous-brown or blackish, with mid-brown edges and apices, to mid-brown with pale-brown edges and apices, scales becoming smaller and often slightly paler, though still remaining ± dense further up the stipe and on the lower half of the rachis, partly deciduous. Lamina twice pinnate, elongated triangular-lanceolate (up to *c.* 30 cm wide), not tapered below, bearing rather few (up to *c.* 20 pairs) rather distant pinnae; pinnae narrowly triangular-lanceolate, herbaceous, matt and pale- to mid-green above, occasionally very slightly glaucous above, bearing up to *c.* 15 pairs of somewhat small pinnules; pinnules short, longer than broad, stalked, or with a narrow point of attachment to the pinna-costa except in the upper part of the pinnae where they become widely attached, not crowded, widest at the base and sloping towards their apices, ± unlobed, or bearing very shallow lobes with rounded apices, except for the basal pair of lobes of the lowest few pinnules on each pinna which are markedly larger than the next and become rounded-auriculate, giving the pinna a cordate base; lobes bearing a few, somewhat insignificant, obtuse teeth, pinnule-apices ± wide, ranging from truncate with rounded corners to rounded, or occasionally obtusely pointed, and bearing somewhat irregular, rather short, wide-based, acute teeth around them. Sori somewhat large, not crowded, in two rows, one on each side of the centre ± near the edges of the pinnules, indusiate; indusia slightly curved down at the edges, somewhat thick, becoming light- to mid-brown, shrivelling and lifting slightly, partly persistent. Spores irregular, with fully formed and abortive spores.

Cytology: Triploid apomict (S. India: Gibby (1985)).

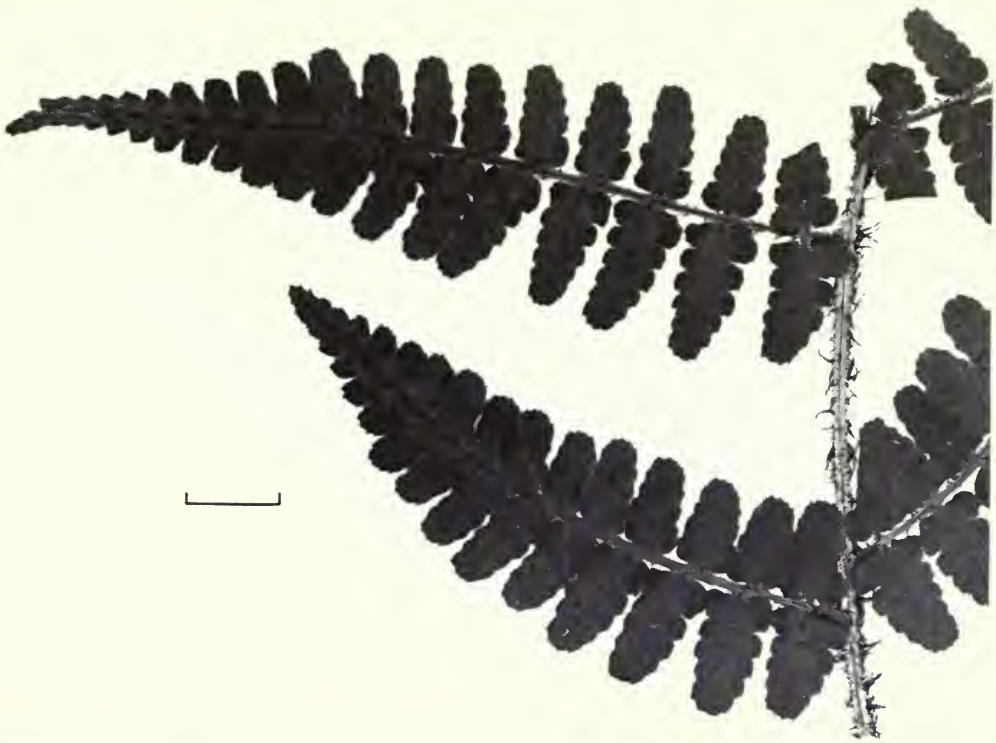

Fig. 34 *Dryopteris odontoloma*. India, Tamil Nadu, Nilgiri Hills, Ootacamund, 25 December 1978, *C. R. Fraser-Jenkins* 9311 (BM). Scale line = 1 cm.

Ecology: A species of the mid-level forest zone, growing on the ground on more or less open roadside banks or among low shrubs by streams, etc., from *c.* 2100–2300 m alt.

Range: India (south). An endemic species of Sino-Himalayan affinity.

Range in the Indian subcontinent: **93** 16 km west of Kotagiri on Ootacamund road, Nilgiri Hills, 2250 m, 26 December 1978, *C. R. Fraser-Jenkins* 9388–9391 (BM!), 9389, 9391, 9393 (H!).

Notes: True *Dryopteris odontoloma* is intermediate in many respects between *D. sublacera* and *D. nigropaleacea* (or *D. juxtaposita*), from which two latter it can easily be distinguished by its more scaly stipe and rachis, its short pinnules with widely auriculate bases, and its more marginal sori with thicker indusia.

Its nomenclature has been much confused (See Hope, 1892) and the name has been applied to several species; it is widely misapplied at present to Himalayan plants. Moore (1858) first used the name *Lastrea odontoloma* to apply to Himalayan *D. juxtaposita*, but gave no description. Beddome (1864) was thus the first to validate the name, which he applied to the present species, the type selected above complying well with his description. Christensen (1924) referred both to Hope and to his own previous reference to *D. odontoloma* in *Index filicum* (1905), both of which referred back to Beddome (1864). He was thus making a new combination based on Beddome's name, even though his own concept was of *D. juxtaposita*. Baker (1874) also referred to Beddome. It is made clear for the first time here that *D. odontoloma* is the south Indian plant and apparently does not occur in the Himalaya. To complicate matters further, Beddome (1876, 1883) subsequently thought that he had made a mistake in 1864 and so temporarily changed his concept and mistakenly applied the name *Lastrea filix-mas* var. *odontoloma* to *D. serrato-dentata*, because Clarke had sent him material of *D. serrato-dentata* erroneously identified as *Nephrodium odontoloma*. At that time Beddome renamed his S. Indian plant as *N. filix-mas* var. *normalis* C. B. Clarke, a synonym of *D. juxtaposita*, which species he did not separate from the

S. Indian one. Later, however, Beddome (1892) realised that Clarke's identification was incorrect and reverted to calling his plant *Lastrea odontoloma* (including in it *D. juxtaposita* and *D. nigropaleacea*). Details of this confusing change are given by Beddome (1892) and more fully by Hope (1892), as well as being traceable on Beddome's herbarium sheets; in particular his manuscript note on the type specimen of *D. odontoloma* is elucidatory 'subsequently another plant having been sent from the Himalayas by Clarke as the true odontoloma I altered this to normalis Clarke, which it is, but a reference to Moore's herbarium proves that this is Moore's original odontoloma'. More recent authors, such as Hope, Stewart, and various Indian workers, have applied the epithet *odontoloma* to a mixture of *D. juxtaposita* and *D. nigropaleacea*. Some reference to this confused situation is also given by Fraser-Jenkins (1979), where the epithet is not applied to these two species.

32. Dryopteris juxtaposita Christ **Fig. 35**

in *Bull. Acad. int. Géogr. bot.* **17**: 138 (1907). Type: China, Yunnan Sen, ravines, 19 November 1905, *F. Ducloux* 99 (P! – lectotype, selected here; P! – isolectotype).

Lastrea odontoloma T. Moore, *Index fil.*: 90 (1858), nom. nud. (Art. 32.1) [non Beddome (1864), nec *Dryopteris odontoloma* (Beddome) C. Chr. (1924)].

Nephrodium filix-mas var. *normalis* C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 519, pl. 68, fig. 2 (1880). – *Aspidium filix-mas* var. *normale* (C. B. Clarke) Christ in *Mém. Soc. bot. Fr.* **1** (1): 38 (1905). Type: India, Sikkim, Singdam, 4000 ft, 12 October 1870, *C. B. Clarke* 13060 (K! – lectotype, selected here).

?*Aspidium erythrosorum* var. *souliei* Christ (1905), see under *Dryopteris cochleata*.

Misapplied name: Dryopteris odontoloma auct.

Fronds medium-sized to large (up to *c.* 100 cm long). Stipe long, *c.* ⅔ the length or the same length as the lamina, the very base clothed with long, narrowly lanceolate, pale brown scales, the widest part of the base clothed with ± large, ovate-lanceolate, thick, glossy scales, varying from mid-brown to almost black but usually of a very dark, castaneous-blackish-brown, rapidly becoming very scattered, smaller, narrower and often somewhat paler further up the stipe, the rachis being nearly devoid of scales except for a few very small, very scattered, very narrow, dark, or pale ones. Lamina twice pinnate, elongated triangular-lanceolate (up to *c.* 40 cm wide), not tapered below, bearing up to *c.* 25 pairs of somewhat distant pinnae, which occasionally become contiguous in more foliose fronds; pinnae with a dark-coloured patch on the costa at the point of attachment to the rachis, elongated triangular-lanceolate, herbaceous, or often slightly crispaceous, pale- to mid-green and very slightly glossy above, ± glabrous, bearing many (up to *c.* 20 pairs) medium-sized pinnules; pinnules longer than broad but ± wide, stalked, or with a narrow point of attachment to the pinna-costa except towards the tips of the pinnae where they become widely attached, not crowded, ± parallel-sided, ranging from unlobed to ± deeply lobed, but mostly shallowly lobed, lobes ± wide, markedly rectangular, usually with truncate apices, the basal pair being the largest, bearing a few insignificant, wide-based, acute teeth, pinnule-apices ranging from ± truncate to ± acutely pointed, but at least those in the upper pinnae somewhat rounded-truncate, bearing somewhat wide-based, acute teeth, the lowest few basiscopic pinnules on the lowest pinnae often markedly curved towards the pinna-apex above their bases, or otherwise, in foliose fronds, more developed compared to the acroscopic ones. Sori sometimes borne throughout the frond, small, not crowded, in two rows, one on each side midway between the centre and margins of the pinnules, though the basal lobes of lower pinnules may themselves bear a few sori in two rows, indusiate; indusia slightly curved down at the edges, ± thin, shrivelling markedly and usually deciduous. Spores irregular, with fully formed and abortive spores.

Cytology: Triploid apomict (W. Himalaya: Gibby (1985). E. Himalaya: Loyal in Mehra (1961), sub *D. odontoloma*. Mehra & Loyal (1965), sub *D. odontoloma*, voucher specimens, *D. S. Loyal*, 15 August 1957 (PAN 2111!), 21 August 1957 (PAN 2225!, 2226!) and *D. S. Loyal* 1, 1958 (PAN 2231!). Gibby (1985). Nepal: Roy, Sinha & Sakya (1971), sub *D. paleacea*, voucher specimen, *A. R. Sakya* 23, Th. no. 11, 2 June 1963 (Herb. Patna Univ.!), and sub *D. odontoloma*).

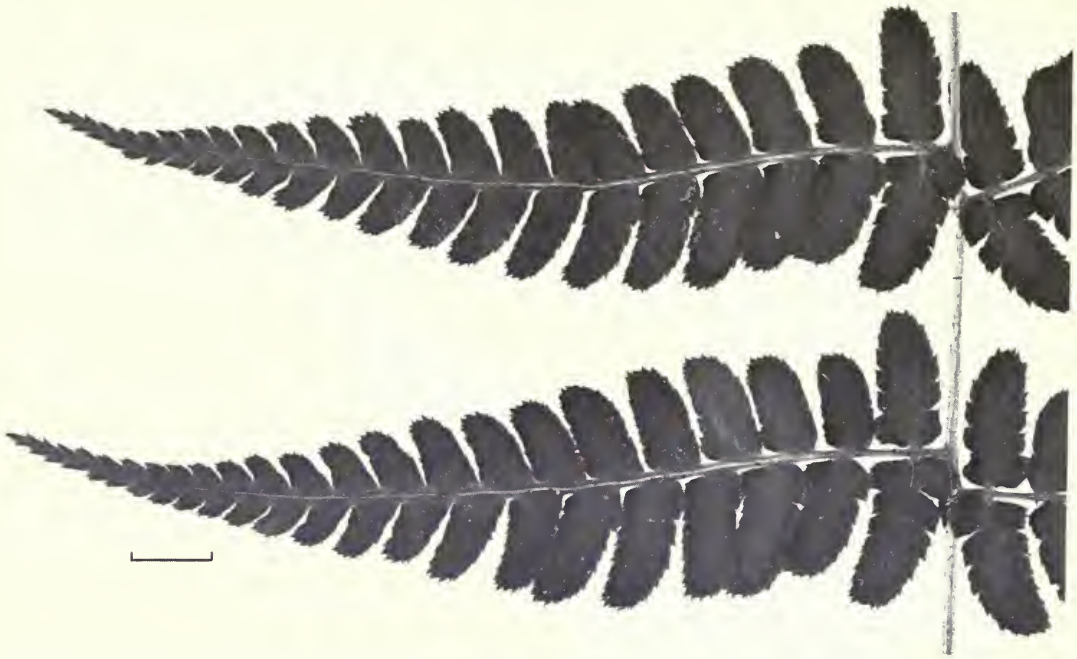

Fig. 35 *Dryopteris juxtaposita.* India, Uttar Pradesh, Chamoli, north of Rudraprayag, west of Sonprayag, Trijugi Naryan, 24 October 1978, *C. R. Fraser-Jenkins* 8218 (FR). Scale line = 1 cm.

Ecology: A species of the mid- and upper-level forest zone, growing on the ground, or more usually on banks or between rocks, sometimes in walls, from *c.* 1400–3400 m alt.

Range: India (central and eastern parts of the W. Himalaya; E. Himalaya in Sikkim and N. Assam; S. India); Nepal; Bhutan; SE. Tibet; N. Burma; China (Yunnan, Szechuan, Kweichow); ?Thailand; N. Vietnam. A Sino-Himalayan species of the widespread sort occurring mainly in the outer ranges of the Himalaya, also reaching parts of SE. Asia and S. India. Not common in the central parts of the W. Himalaya.

Range in the Indian subcontinent: **27** 7 miles from Banihal towards Ramban, 15 May 1954, *P. Chandra* 10185 (LWG!); **35** Kulu, Kangra, 5000 ft (1520 m), 1–5 June 1933, *W. Koelz* 4776 (MICH!); **37** North side of Mt Hattu, 3 km east of Narkanda, north-east of Simla, 2600 m, 6 September 1977, *C. R. Fraser-Jenkins* 6987–6989 (BM!), 6987 (PE!); **39** Jaunsar, Deoban, 8500 ft (2590 m), 6 June 1936, *C. E. Parkinson* 7071, 7073 (DD!, E!); **40** 6 km north of Mussoorie on Jumna Bridge road, north of Dehra Dun, 1650 m, 21 October 1978, *C. R. Fraser-Jenkins* 8163, 8164 (BM!), 8166 (PE!); **42** About 1½ km below Trijugi Naryan, west from Sonprayag, Mandakini valley, north of Rudraprayag, *c.* 1900 m, 24 October 1978, *C. R. Fraser-Jenkins* 8210–8212, 8217 (BM!), 8218 (FR!), 8210–8216, 8219, 8221, 8223–8228 (H!), 8233 (PE!); **43** 3 km south of Joshimath, north-east of Rishikesh, Alaknanda valley, 1700 m, 17 September 1977, *C. R. Fraser-Jenkins* 7241 (BM!, PE!); **44** Pauri to Khirsa road, *S. Basu* (CAL!); **45** Palari, near Bageswar, 4000 ft (1220 m), 4 September 1891, *E. W. Trotter* 705 (P!, RAW!); **50** Silgiri to Doti, 7000 ft (2130 m), November 1959, *R. L. Fleming* 1752 (MICH!); **51** Jumla to Mugu, 10 miles north-east of Gum, Dolpo District, 7000 ft (2130 m), February 1971, *R. L. Fleming* 1991 (MICH!); **54** Above Tukuche, 11,500 ft (3490 m), 1 December 1949, *R. L. Fleming* 888 part (MICH!); **55** Marsyandi valley, Bagarchap to Thimang, 2400 m, 23 September 1969, *T. Wraber* 367 (BM!); **57** Maikot, 8000 ft (2440 m), 9 October 1954, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 4777 (BM!, E!); **58** Phulchoki, south of Kathmandu, 1970 m, 21 October 1970, *H. Kanai & P. R. Shakya* (KATH!); **59** Ghoda Tabela to Thulosyapru, district Rasuwa, Langtang, 2120 m, 7 October 1977, *V. L. Gurung & party* 77/743 (KATH!); **62** Mure to Sinduwa, 2100 m, 5 June 1972, *H. Kanai et al.* 725075 (KATH!); **63** 3 miles west of Raja Rani, Palamtar, 1828 m, 3 October 1978, *R. L. Fleming* 2596 (KATH!); **64** 1 km from the north end of Tensing Norgay road towards Aloo Beri, east side of the Darjeeling ridge, *c.* 2200 m, 20 November 1978, *C. R. Fraser-Jenkins* 8736, 8737 (BM!); **65** Chungthang, 6000 ft (1830 m), July 1958, *D. S. Loyal* (PAN 2500–2502!); **67** Bhotan, *W. Griffith*

2775 (BM!); **68** Samtengang (1900 m) to Sena Thang (2400 m) to Tsarza La (2600 m) to Ratsoo (1850 m) to Ritang (2400 m), 11 April 1967, *H. Hara et al.* 3481 (TI!); **74** Kameng, Kalaktang to Norsing, 18 May 1958, *G. Panigrahi* 15858 (ASSAM!); **80** Ukhrul, Makui Kong Forest, 29 February 1978, *R. D. Dixit* 58893 (CAL!); **83** Forest below Peak Lodge, 10 km above Shillong on road to the peak, Khasi Hills, 1800 m, 24 November 1978, *C. R. Fraser-Jenkins* 8816, 8818 (BM!, H!); **93** 16 km west of Kotagiri, on Ootacamund road, Nilgiri Hills, 2250 m, 26 December 1978, *C. R. Fraser-Jenkins* 9364, 9365, 9367 (BM!), 9365–9376, 9378–9383 (H!); **95** Rocks above park, 1½ km south-west of Kodaikanal centre on Berijam road, Palni Hills, 1100 m, 21 December 1978, *C. R. Fraser-Jenkins* 9226, 9228 (BM!), 9222–9227 (H!).

Notes: Dryopteris juxtaposita is reported here from the Indian subcontinent for the first time under this name. Although described in 1907, it has until now been sunk into the synonymy of *D. odontoloma*, a widely misapplied name, by Christensen (1934), Ching (1938), and later authors. It was first recognised from the area as a distinct entity by Loyal in Mehra (1961) and Mehra & Loyal (1965) as their triploid '*D. odontoloma*', though Hope (1892) had noticed some difference between the Himalayan taxa in the group as he mentioned that Clarke's eastern Bengal plants (*D. juxtaposita*) were 'poor and stunted ones' when compared to the common west Himalayan plants (*D. nigropaleacea* and *D. stewartii*). He thought that this was due to climate, though *D. juxtaposita* is frequently somewhat stunted, owing to its preference for growing on steep rocky banks.

Dryopteris juxtaposita can be distinguished from the closely related species, *D. nigropaleacea*, by its tendency to have slightly browner stipe-base scales, its less blue-green, very slightly glossy lamina (especially recognisable in the living state), and in particular by its wider pinnules with more truncate apices and more rectangular pinnule side-lobes in the lower pinnae (when lobes are present). It can readily be confirmed by a quick examination of a dry spore sample under the microscope, the much larger spores of *D. juxtaposita* being instantly recognisable even without measuring. Some of the more foliose plants, in China, etc. and especially those in southern India, may have more pointed pinnule-apices and can be more difficult to distinguish from *D. nigropaleacea* or even *D. stewartii*, though at least the pinnules in the upper part of the lamina are wider and more truncate. Although the spore-size of *D. stewartii* is similar to that of *D. juxtaposita* there is normally no difficulty in distinguishing the fronds of the two. However, occasional foliose plants of *D. juxtaposita* approach *D. stewartii* and can be distinguished by the stipe-scales being darker and more glossy and more confined to the stipe-base in *D. juxtaposita*, as well as by the more truncate and less dissect upper pinnules.

Recently Mehra & Khullar (1980) have reported a triploid '*D. odontoloma*' from Kashmir, which they assumed to be the same as the east Himalayan triploid (i.e. *D. juxtaposita*). However, their specimens (in PAN!) are *D. stewartii*, which, at the time Mehra & Khullar's paper was sent to press (in 1972), had not been described.

D. juxtaposita replaces *D. nigropaleacea* in the Himalaya from approximately the Indian/west Nepalese border eastwards, though *D. nigropaleacea* probably occurs scattered through parts of west Nepal near the main Himalayan range and may have been undercollected. *D. juxtaposita* is also fairly common in the eastern parts of the west Himalaya in the higher parts of the outer ranges (i.e. the ranges nearer to the plains), but is rare further westward. The two species are presumably closely related and Mehra & Loyal (1965) state that *D. juxtaposita* is an auto-triploid, perhaps based on *D. nigropaleacea*, with a high degree of trivalent formation in the 16-celled sporangia, though only one cell was examined (Loyal, pers. comm. 1979), but this is not borne out by Gibby (1985), nor by its distinctive morphology. Further complications exist because the chromosome pairing behaviour in what is apparently all one taxon (based on frond morphology) is not always similar from plant to plant (Gibby, 1985), thus suggesting the need for further investigation. There is in addition a degree of morphological variation, with some plants from the central-west Himalaya (e.g. among *C. R. Fraser-Jenkins* 8217, 8220, 8229 (BM!), 8233 (PE!), 8230–8234, etc. (Herb. C. R. Fraser-Jenkins!) from Mongu, Trijugi Naryan, Uttar Pradesh) having less dissect pinnules with more rounded apices and slightly more dark scales scattered on the lower rachis (and perhaps also a slightly more glossy upper surface of the lamina), whereas other plants from both the west and east Himalaya have more pointed and dissect pinnules and less scales. Neither the cytological behaviour nor the slight degree of

chemical variation in the phloroglucides (Widén et al., in prep.) within *D. juxtaposita* seem to tie up with any of the morphological variants.

33. Dryopteris nigropaleacea (Fraser-Jenkins) Fraser-Jenkins **Fig. 36**

in *Bolm Soc. broteriana* II, **55**: 238 (1982). – *Dryopteris pallida* subsp. *nigropaleacea* Fraser-Jenkins in *Candollea* **32** (2): 316 (1977). Type: India, Mussoorie, August 1953, *D. S. Loyal* 71 (BM! – holotype; PAN 1240! – isotype).

Misapplied names: Aspidium pallidum sensu Boissier (1884), pro parte; *Dryopteris pallida* sensu R. Stewart (sub 'Dubia') (1972); *Nephrodium filix-mas* var. *normalis* C. B. Clarke (1880), pro parte min.; *Aspidium filix-mas* var. *normale* (C. B. Clarke) Christ (1905), pro parte min.; *Nephrodium rigidum* sensu C. B. Clarke (1880); *Lastrea rigida* sensu Beddome (1883); *Dryopteris odontoloma* auct.

Fronds medium-sized (up to *c.* 90 cm long). Stipe long, *c.* ½ to ⅔ the length of the lamina, the very base clothed with long, narrowly lanceolate, pale brown scales, the widest part of the base clothed with ± large, ovate-lanceolate, thick, glossy, blackish scales (rarely very dark castaneous-brown), which rapidly become very scattered further up the stipe, smaller, narrower and often somewhat paler, the rachis being nearly devoid of scales except for a few small, very scattered, very narrow, usually pale ones. Lamina twice pinnate, elongated triangular-lanceolate (up to *c.* 30 cm wide), not tapered below, bearing up to *c.* 20 pairs of ± contiguous pinnae; pinnae with a dark-coloured patch on the costa at the point of attachment to the rachis, elongated triangular-lanceolate, crispaceous, somewhat bluish-green above when living, and glaucous below, ± matt, ± glabrous, bearing many (up to *c.* 18 pairs) somewhat small to medium-sized pinnules; pinnules somewhat long, ± narrow, stalked, or with a narrow point of attachment to the pinna-costae except towards the tips of the pinnae where they become widely attached, not crowded, ± parallel-sided, ranging from unlobed to ± deeply lobed, lobes ± narrow, rectangular, usually with rounded-truncate apices, bearing a few insignificant, acute teeth, pinnule-apices ranging from rounded to acutely pointed, bearing acute teeth. Sori small, not crowded, in two rows, one on each side midway between the centre and margins of the pinnules, indusiate; indusia slightly curved down at the edges, ± thin, shrivelling markedly and often deciduous. Spores regular.

Cytology: Diploid sexual (W. Himalaya: Verma & Loyal (1960), sub *D. odontoloma*. Loyal in Mehra (1961), sub *D. odontoloma*. Mehra & Loyal (1965), sub *D. odontoloma*, voucher specimens, *D. S. Loyal* 71, August 1953 (BM!, PAN 1240!), September 1955 (PAN 2224!, 2497!, 2499!), and February 1958 (PAN 2233!). Mehra & Khullar (1980), voucher specimens, *S. P. Khullar* 120, July 1967 (PAN 5961!, 6071!). Gibby (1985)).

Ecology: A species of the mid-level forest zone, growing on the ground, usually in light forest, from *c.* 1300–2600 m alt.

Range: Pakistan (Himalaya west and east of the Indus, and recorded by Hope (1903) from the more southerly ranges bordering Afghanistan); India (W. Himalaya); W. central Nepal (rare). A Sino-Himalayan species of the west Himalayan sort.

Range in the Indian subcontinent: **8** Murgha (Hope, 1903), specimen not seen, probably in US; **9** Dehra Ismail Khan, Pingul, *Rev. J. Williams* (Hope, 1903), specimen not seen, probably in US; **10** Tirah, Lunda War, 3 and 4 August 1965, *Naseeb Khan* (PPFI!); **12** Dir, Kulandi, 6000 ft (1830 m), *Muqarrab Shah & Dilawar* 2640 (ISL!); **13** Bazar Kot, Chitral, 6800 ft (2070 m), *Muqarrab Shah & Dilawar* 1640 (ISL!); **14** About 4 km south of Madyan, north of Saidu Sharif, mid Swat valley, 1300 m, 1 October 1978, *C. R. Fraser-Jenkins* 7892 (BM!); **20** 1 km north of Murree on Muzaffarabad road, 2000 m, 24 July 1977, *C. R. Fraser-Jenkins* 6230, 6250, 6251 (BM!), 6232, 6233 (H!), 6238 (CANU!), 6240, 6244 (PE!); **21** Mera [Maigra, Jhelum valley] to Marree [Murree], 5–7000 ft (1520–2130 m), 1856, *H. Schlagintweit* 11552, 12406 (B!); **22** Nakial, beyond Kotli, 5000 ft (1520 m), 20 April 1954, *R. R. Stewart* (BM!, RAW!); **23** Poonch, 1100 m, 1972, *H. Kiru* 1472 (PUN!), and Prov. Rajauri, Uri, across the Puch Pass via Kahuta to Puch [Poonch], 5–9000 ft (1520–2740 m), 6–9 November 1856, *H. Schlagintweit* 12166 (86) (BM!); **24** Gulmarg, August 1965, *S. P. Khullar* 37 b & c (PAN!); **25** Titwal to Surkhala, Kishenganga valley, 12 July 1939, *R. R. Stewart* (RAW!); **26** South side of Sind valley, 3 km east of Gund, Sonamarg to Ganderbal, north-east of Srinagar, 2400 m, 27 July 1977, *C. R. Fraser-Jenkins* 6554 (BM!); **28** ½ km north of Patnitop,

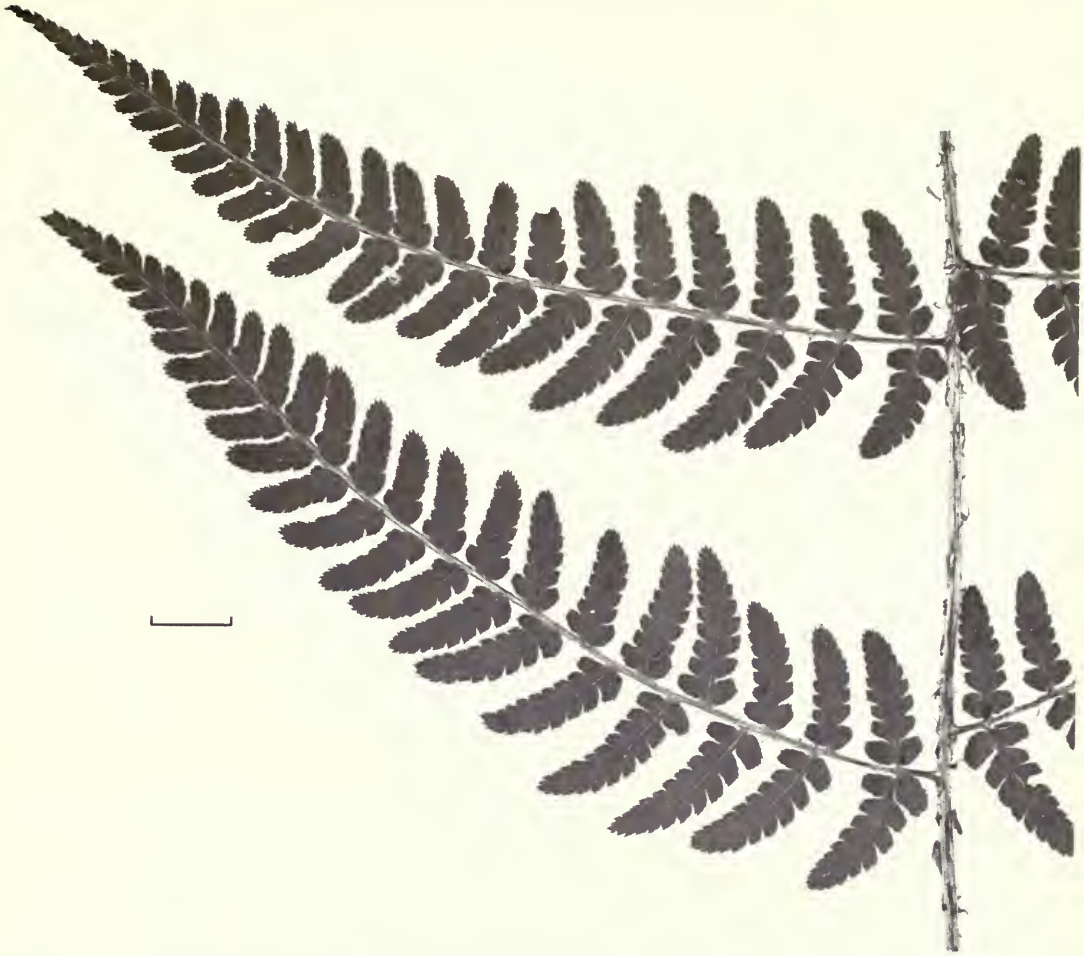

Fig. 36 *Dryopteris nigropaleacea.* Pakistan, Rawalpindi Province, Murree, 24 July 1977, *C. R. Fraser-Jenkins* 6230 (BM). Scale line = 1 cm.

Chineni to Ramban, north of Jammu, 2200 m, 19 August 1977, *C. R. Fraser-Jenkins* 6458, 6459 (BM!), 6460 (Herb. T. Reichstein, Basel!); **29**, Tolti, Baltistan (CAL!); **32** Side-gorge, *c.* 20 km above Tissa on Satrundi road, north of Ravi valley, north-west of Chamba, *c.* 2100 m, 9 September 1978, *C. R. Fraser-Jenkins* 7785 (BM!); **33** 4 km north-west of Nainikhad, south of Dalhousie, 1500 m, 30 August 1977, *C. R. Fraser-Jenkins* 6633–6635 (BM!); **35** About 2 miles above Baragran village up side valley, Kulu to Manali, 1700 m, 4 September 1977, *C. R. Fraser-Jenkins* 6899–6901 (BM!); **36** Lahul (CAL!); **37** Dhobi Khad, Simla, 1800 m, *S. P. Khullar* 120 (PAN 5961!, 6071!); **39** Jaunsar, below Kathyan, 7–8000 ft (2130–2440 m), 14 May 1893, *J. F. Duthie* 12941 (K!); **40** Mussoorie, 6500 ft (1980 m), July 1930, *R. R. Stewart* 12258 (K!); **42** About 1½ km below Trijugi Naryan, west from Sonprayag, Mandakini valley, north of Rudraprayag, *c.* 1900 m, 24 October 1978, *C. R. Fraser-Jenkins* 8240, 8241 (BM!), 8235 (H!); **43** Badrinath, 1982, *S. P. Khullar* 5240 (PAN!); **44** Garhwal, Bhuna (CAL!), and Pauri, 1982, *S. P. Khullar* 5226 (PAN!); **45** Kumaon, May 1845, *T. Thomson* 1006 (K!); **46** 1 km below Chaubattia on Ranikhet road, north of Nainital, 29 October 1978, *C. R. Fraser-Jenkins* 8419, 8420 (BM!); **47** Naina Peak, 7000 ft (2130 m), *S. P. Khullar* 37 (PAN!); **48** Kumaon, 6–8000 ft (1830–2440 m), *R. Strachey & J. E. Winterbottom* 10 (K!); **57** Near Banglep, 2600 m, 24 May 1973, *P. R. Shakya & T. K. Bhattacharya* 2307 (KATH!).

Notes: Dryopteris nigropaleacea has not previously been separated from other members of the *D. odontoloma* group, though it was recognised as cytologically distinct from the east Himalayan triploid, now clarified as *D. juxtaposita*, by Mehra & Loyal (1965). Hope (1892) gives details of some of the nomenclatural confusion surrounding this fern and (1903) followed

Boissier (1884) in pointing out its close relationship to the European and west Asian species, *D. pallida*. Records of *D. pallida*, often under names commonly misapplied to other members of the *D. pallida* and *D. submontana* (Fraser-Jenkins & Jermy) Fraser-Jenkins group in Europe, such as *Lastrea rigida* (Sw.) C. Presl, from Afghanistan eastwards, therefore refer to *D. nigropaleacea* and often, in error, to *D. juxtaposita* as well.

D. nigropaleacea is distinguishable from *D. juxtaposita* by its narrower pinnules with smaller, less rectangular lobes (somewhat smaller in all its parts) and normally by its less truncate pinnule-apices; the lamina is also more blue-green above when living, and dries a somewhat glaucous colour. Its markedly smaller spores are a highly diagnostic feature of distinction from both *D. juxtaposita* and *D. stewartii*. Some difficulty with similar frond morphology may arise with more foliose plants of *D. juxtaposita* which develop pointed pinnule-apices, mainly in the lower pinnae. Also, some of the outer range populations of *D. nigropaleacea* from the eastern part of its range (Chhachpur, area 37; Mussoorie, area 40; Almora, area 46; and Nainital, area 47) consist mainly of larger, more luxuriant plants with larger pinnules than the populations towards the west of its range, thus approaching *D. juxtaposita*. Spore dispersal in *D. nigropaleacea* has been studied by Loyal (1981, sub *D. odontoloma*; 1985).

34. Dryopteris stewartii Fraser-Jenkins **Fig. 37**

in *Kalikasan* **7**: 272 (1979 ['1978']). Type: N. Pakistan, Hazara, Murree to Abbotabad, ½ km north of Changla Gali, 25 July 1977, *C. R. Fraser-Jenkins* 6295 (BM! – holotype). Other specimens from the type locality are located as follows: 6284–6289 (BM!), 6292 (BR!), 6271 (FR!), 6291 (G!), 6293–6300 (Herb. C. R. Fraser-Jenkins!), 6269, 6301 (Herb. T. Reichstein, Basel!).

Dryopteris odontoloma forma *brevifolia* Mehra & Khullar in *Res. Bull. Panjab Univ.* II, **25** (3–4): 147, fig. 12 (1980 ['1974']), nom. inval. (Art. 36.1). Specimens in PAN (5425!, 5426!).

Misapplied names: Dryopteris odontoloma auct., pro parte; *Dryopteris ramosa* auct., pro parte.

Fronds large (up to *c.* 110 cm long). Stipe long, up to *c.* ½ the length of the lamina, the very base clothed with long, lanceolate, pale brown scales, the widest part of the base somewhat densely clothed with large, ovate-lanceolate, ± thick, glossy scales, varying from mid-brown with a very dark castaneous-brown base and centre to all very dark castaneous-brown, becoming more scattered further up the stipe, smaller and often pale brown, rachis bearing scattered, very small, mid- to dark brown, lanceolate scales, mainly near its base. Lamina twice pinnate, a third time pinnatifid below, slightly elongated triangular-lanceolate (up to *c.* 36 cm wide), not tapered below, bearing up to *c.* 20 pairs of contiguous, or slightly overlapping pinnae; pinnae elongated triangular-lanceolate, herbaceous, pale- to mid-green and ± glabrous above, bearing many (up to *c.* 18 pairs) large pinnules; pinnules long, stalked, or with a narrow point of attachment to the pinna-costae except near the tips of the pinnae where they become widely attached, somewhat crowded, ± parallel-sided, ranging from very shallowly lobed in plants from more exposed places to markedly and deeply lobed, lobes crowded, ± rectangular with rounded-truncate apices, bearing several acute teeth, pinnule-apices acutely pointed and often somewhat long-pointed, bearing acute teeth, the pinnules on the basiscopic side of the lower few pinnae often somewhat developed when compared with those on the acroscopic side. Sori small, not crowded, in two rows, one on each side midway between the centre and margins of the pinnules, the lobes in the lower pinnules often bearing two short rows of sori, indusiate; indusia ± flat, or slightly curved down at the edges, but the edges not tightly adpressed to the sorus except in plants from exposed places, ± thin, shrivelling markedly and mostly deciduous. Spores irregular, with fully formed and abortive spores.

Cytology: Triploid apomict (W. Himalaya: Gibby in Fraser-Jenkins (1979), voucher specimen, *C. R. Fraser-Jenkins* 6804, 2 September 1977 (BM!). Mehra & Khullar (1980), sub *D. odontoloma* forma *brevifolia*, voucher specimens, *S. P. Khullar* 65, June 1966 (K!, PAN 5425!, 5426!). Gibby (1985)).

Ecology: A species of the mid- and upper-level forest zone, growing on the ground in the forest or in open places at roadsides, etc., from *c.* 1700–3300 m alt.

Fig. 37 *Dryopteris stewartii*. Pakistan, Hazara, upper Kunhar (Kagan) valley, Kagan, Naran, 10 August 1977, *C. R. Fraser-Jenkins* 6406 (FR). Scale line = 1 cm.

Range: NE. Afghanistan; Pakistan (Himalaya west and east of the Indus); India (W. Himalaya); W. Nepal. A Sino-Himalayan species of the west Himalayan sort.

Range in the Indian subcontinent: **2** Ningalam (1300 m) to Darim Ort (1900 m), *H. Neubauer* 964 (W!); **10** Kurrum valley, Shend Toi, 9–11,000 ft (2740–3340 m), 21 May 1879, *J. E. T. Aitchison* 384 (DD!, K!) and 31 May 1879, *J. E. T. Aitchison* 455 (K!); **12** Dir, 8000 ft (2440 m), 14 May 1895, *S. A. Harriss* 16870 (DD!); **13** Mirga, 8000 ft (2440 m), August 1895, *Brig.-Gen. W. Gatacre* 17644 (BM!); **14** North-west side of mountain west of Kalam, east of Utrot, upper Swat valley, 2700 m, 2 October 1978, *C. R. Fraser-Jenkins* 7968–7970 (BM!); **15** Birik in Gilgit, Balti, 10,000 ft (3040 m), 1847, *J. E. Winterbottom* (K!); **20** 3 km below Naran, above Kagan, upper Kunhar (Kagan) valley, 2300 m, 10 August 1977, *C. R. Fraser-Jenkins* 6397, 6400–6402 (BM!), 6406 (FR!); **21** Shardi, 2000 m, 1–10 August 1953, *F. Schmid* 592 (BM!); **23** Dhuli, 5–6000 ft (1520–1830 m), 18 April 1952, *R. R. Stewart & E. Nasir* 23775 (RAW!); **24** North-east slope of Mt Apharwat, above Gulmarg, Pir Panjal range, west of Srinagar, 2600 m, 24 August 1977, *C. R. Fraser-Jenkins* 6466 (BM!), 6468 (PE!); **25** Prang [nr Sonamarg], 14 October 1970, *V. L. Shrestha* 145 (KATH!); **26** South side of Sind valley, 3 km east of Gund, Sonamarg to Ganderbal, north-east of Srinagar, 2400 m, 15 August 1978, *C. R. Fraser-Jenkins* 7427, 7428 (BM!), 7427–7429 (H!), 7426 (PE!); **27** Pir Panjal Pass, Banihal ridge, 14 September 1958, *T. A. Rao* 7660 (DBS!); **28** Bassahir, 7000 ft (2130 m), May 1881, *D. Brandis* (DD!); **29** Nallah *c.* 2 km above Chanigund, west of Kargil, 3250 m, 18 August 1978, *C. R. Fraser-Jenkins* 7457 (BM!, H!); **32** Forest 15 km below Satrundi, north of Tissa, north of Ravi valley, north-west of Chamba, 2700 m, 10 September 1978, *C. R. Fraser-Jenkins* 7852, 7853 (BM!), 7852–7859 (H!); **33** Upper Bakrota, Dalhousie, 2400 m, 8 August 1962, *K. K. Dhir* 8 (PAN 5533!); **35** 5 km above Kothi, 18 km above Manali, south side of Rohtang Pass, north of Mandi, north of Simla, 2700 m, 2

September 1977, *C. R. Fraser-Jenkins* 6804, 6805 (BM!), 6803 (Herb. T. Reichstein, Basel!); **37** Mahasu, Sirmur, 8000 ft (2440 m), 4 June 1849, *T. Thomson* (K!), and 3 km east of Matiana, Simla to Narkanda, 2400 m, 6 September 1977, *C. R. Fraser-Jenkins* 6970 (BM!); **39** Jaunsar, Konam, 27 April 1929, *H. G. Champion* 50817 (DD!); **40** Mussoorie, *Dr Bacon* (K!); **42** About 1½ km below Trijugi Naryan, west from Sonprayag, Mandakini valley, north of Rudraprayag, 1900 m, 24 October 1978, *C. R. Fraser-Jenkins* 8251 (BM!); **43** Badrinath, 1982, *S. P. Khullar* 5241 (PAN!); **44** Pauri, 1982, *S. P. Khullar* 5225 (PAN!); **51** Jumla, 8000 ft (2440 m), 11 December 1977, *R. L. Fleming* 2413 (MICH!).

Notes: In sheltered places, in rich forests, etc., *Dryopteris stewartii* can become very large and luxuriant and similar to a more coarsely dissected and lobed version of *D. ramosa*, with darker stipe scales; but in open, drier places, especially in the far west Himalaya, it remains less developed and more similar to *D. nigropaleacea* or to the more foliose plants of *D. juxtaposita*, though with longer pinnules than either and with more coarsely lobed pinnules than *D. nigropaleacea*. The markedly smaller spores of *D. nigropaleacea* and *D. ramosa* provide a highly reliable means of distinguishing them from *D. stewartii*, and the paler and more numerous stipe-scales and longer, narrower pinnules and wider lamina base distinguish *D. stewartii* from *D. juxtaposita*. In many respects *D. stewartii* is intermediate between *D. ramosa* and *D. nigropaleacea*, but from its cytology it is clear that its relationship to them is not an example of an allotetraploid (amphidiploid) and its two ancestral diploid species. The relationship between all three species and also *D. juxtaposita* requires further investigation.

D. stewartii is common throughout most of the range of *D. ramosa* and *D. nigropaleacea*, and plants of it were responsible for Stewart's (1945) statement that '*D. odontoloma*' could be difficult to distinguish from *D. ramosa* (and *D. marginata*), occupying a position of more or less intermediate morphology. The species was also probably part of the origin of Hope's (1892) statement that the further north-westward '*D. odontoloma*' is found the more developed it appears to become. Mehra & Khullar's (1980) report of a triploid '*D. odontoloma*' from Kashmir, which they had assumed to be the same as the east Himalayan triploid, *D. juxtaposita*, refers to *D. stewartii* (voucher specimens in PAN!).

35. **Dryopteris lachoongensis** (Beddome) Nayar & Kaur **Fig. 38**

Comp. Beddome's Handb. ferns Brit. India: 61 (1972). – *Lastrea filix-mas* var. *lachoongensis* Beddome, *Suppl. ferns Brit. Ind.*: 58 (1892). Type: India, Sikkim, Lachung, *c.* 12,000 ft, November 1882, 'Fide Bootia Colln. *Burr*, Herb. H. C. Levinge' (K! – lectotype, selected here; CAL! – isolectotype). Another similarly labelled specimen in G! is *Dryopteris fructuosa*.

Dryopteris venosa Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 264, fig. 63, 1–2 (1983). Type: Tibet, Cha Yu, 2200 m, 4 July 1973, *Chinghai-Xizang Expedition* 73-566 (PE! – holotype).

Dryopteris pseudodontoloma Ching in Cheng-yih Wu, *Fl. xizangica* **1**: 265, fig. 63, 3–4 (1983). Type: Tibet, Pome, Sie Ku Xian, 95° 30′E, 29° 55′N, 2900 m, 11 June 1965, *Yin, Ch.-Xi* 0218 (PE! – holotype; PE! – isotypes).

Fronds medium-sized (up to *c.* 60 cm long). Stipe long, *c.* ⅓ to ½ the length of the lamina, densely clothed at the very base with a tuft of long, narrowly-lanceolate, matt, russet-brown scales, and clothed at the widest part of the base with lanceolate, matt, very slightly russet, pale-brown scales, often with very dark brown bases, rapidly becoming very scattered and smaller further up, upper part of the stipe and rachis ± glabrous except for a very few, very scattered, small, very narrow, pale brown scales. Lamina twice pinnate, triangular-lanceolate (up to *c.* 25 cm wide), not tapered below, bearing rather few (up to *c.* 15 pairs) ± separate pinnae; pinnae elongated triangular-lanceolate, somewhat coriaceous, mid- to somewhat pale green and matt above, ± glabrous, the veins rather markedly impressed in the upper surface, bearing up to *c.* 12 pairs of large pinnules; pinnules long, wide, stalked at the bases of the pinnae, but becoming broadly attached to the pinna-costae and joined to each other at their bases further up, the lower ones slightly sloping from a wide base towards their apices, the upper ones ± parallel-sided, the lower ones becoming somewhat deeply lobed with broad, rectangular lobes with rounded-truncate apices, the upper ones unlobed, lobes ± untoothed, pinnule-apices wide, truncate or becoming rounded-truncate in the lowest few pinnae, bearing somewhat few, ± short, wide-based, acute teeth around them, pinnules on the basiscopic side of the lowest pair of

pinnae somewhat developed and longer than those on the acroscopic side. Sori very large (the largest in the genus), tall, slightly crowded, in two rows, one on each side of the centre of the pinnule, indusiate; indusia markedly curved down but not inflected at the edges, thick, becoming brown, shrivelling slightly, lifting and mostly falling off later when the sorus also sheds a number of sporangia and becomes smaller. Spores irregular, with fully formed and abortive spores.

Cytology: Unknown.

Ecology: A species of the upper-level forest zone, growing on the ground, from *c.* 3000–3800 m alt.

Range: India (E. Himalaya in Sikkim and possibly further east); ?E. Nepal; ? Bhutan; SE. Tibet; China (Yunnan, Szechuan, Kweichow); Taiwan. A Sino-Himalayan species of the east Himalayan sort.

Range in the Indian subcontinent: **65** As above, type of *D. lachoongensis*.

Notes: An uncommon species known only from a handful of collections, mainly preserved in Peking, from the Chinese and Tibetan side of the east Himalaya, one collection from Sikkim, and a few from Taiwan. Beddome (1892) cited two specimens from Sikkim, only one of which

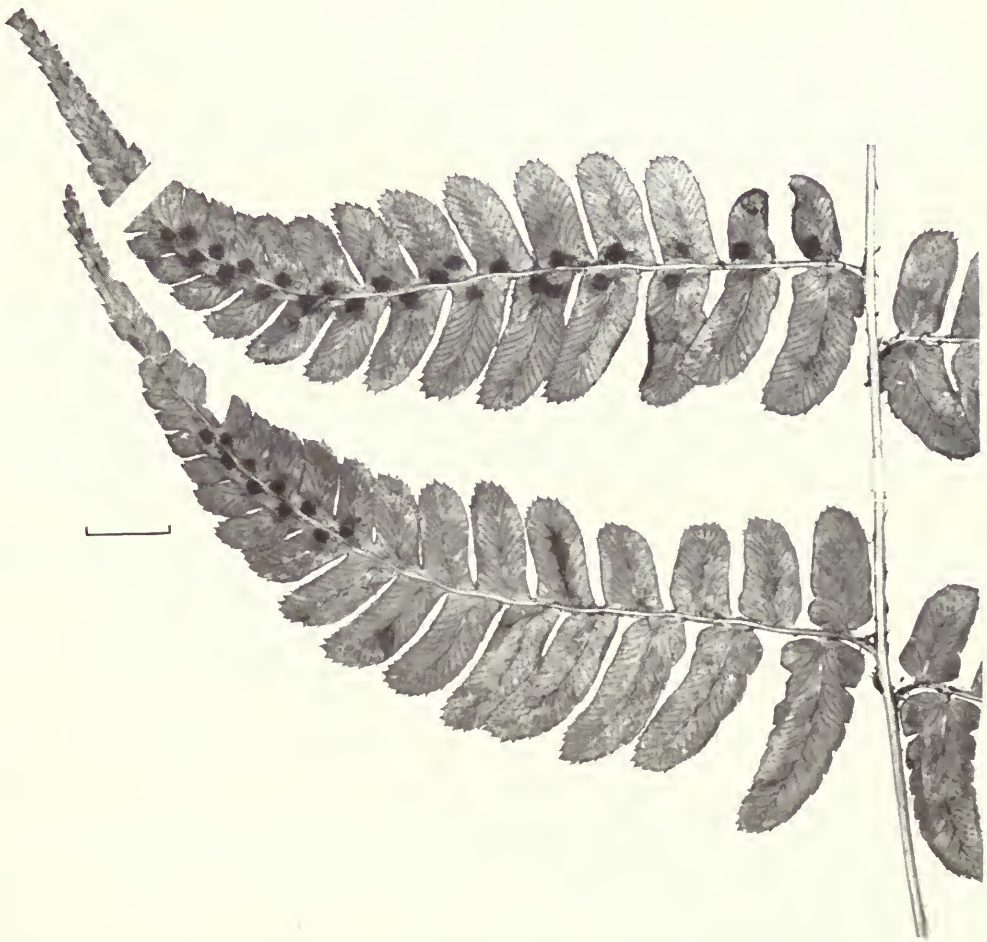

Fig. 38 *Dryopteris lachoongensis*. India, Sikkim, Lachung, November 1882, Bootia colln, *Burr* (K – lectotype). Scale line = 1 cm.

has been found by the author, but as this matches the description in the protologue it is chosen here as the lectotype.

Dryopteris lachoongensis is presumably closely related to *D. fructuosa*, though it is not known how. The relationship requires investigation, particularly as some specimens of *D. fructuosa* are similar to *D. lachoongensis* in their morphology. However, *D. lachoongensis* appears to be a distinct species distinguishable from *D. fructuosa* mainly by its very large, wide segments, with fewer, shorter teeth, a markedly paler green and less glossy lamina, paler, more matt stipe-base scales, and larger sori. A number of specimens of *D. fructuosa*, including the type, have large, more or less undissect segments, but are distinct in their darker lamina and markedly more prominent, longer pinnule-teeth, and usually less rectangular pinnules. Mehra & Loyal (1965) tentatively included *D. lachoongensis* in *D. fructuosa*, though they mention that they had not seen the type. Nayar & Kaur (1972), unaware of *D. fructuosa*, fortuitously raised the epithet *lachoongensis* to the specific level.

Ching & Wu's *D. venosa* was distinguished from Ching's *D. pseudodontoloma* because of its markedly larger sori; however, this is only a stage of development, all the specimens of *D. pseudodontoloma* at PE being at a stage of advanced dehiscence so that the sori have shed many sporangia and become smaller, and the indusia are more shrivelled or have dropped off.

36. Dryopteris fructuosa (Christ) C. Chr. **Figs 39–40**

Index filic.: 267 (1905). – *Aspidium varium* var. *fructuosum* Christ in *Bull. Herb. Boissier* **6**: 967 (1898). – *Aspidium fructuosum* (Christ) Christ in *Mém. Soc. bot. Fr.* **1** (1): 38 (1905). – *Nephrodium fructuosum* (Christ) Hand.-Mazz., *Symb. sin.* **6**: 24 (1929). Type: China, Yunnan, S. of Red River from Manmei, 6000 ft, *A. Henry* 10,095 (P! – lectotype, selected here; K! – isolectotype).

Aspidium pseudovarium Christ in *Mém. Soc. bot. Fr.* **1** (1): 42 (1905). – *Dryopteris pseudovaria* (Christ) C. Chr., *Index filic.*: 287 (1905). Type: China, Environs de Yun-Nan-Sen, 23 December 1896, *Em. Bodinier* [*& Fr. Ducloux*] 2543 (P! – lectotype, selected here).

Dryopteris hypophlebia Hayata, *Icon. pl. formos* **4**: 154, fig. 95 (1914). Type: Taiwan, Arisan, January 1912, *B. Hayata* [*& S. Sasaki*] (TI! – holotype).

Dryopteris pseudo-sabaei Hayata, *Icon. pl. formos.* **5**: 283, fig. 110 (1915). Type: Taiwan, Arisan, between Mingetsu and Senninbora, April 1914, *B. Hayata & Takeo Itô* (TI! – holotype).

Dryopteris cavaleriei A. Léveillé, *Fl. Kouy-Tchéou*: 490 (1915), nom. illeg. (Art. 64.1), non (Christ) C. Chr. (1905). – *Dryopteris adenorachis* C. Chr., *Index filic. Suppl. prélim*: 13 (1917). Type: China, [Yuin Lui Tch'eou], Kouy-Tcheou, [3 July 1874], *J. Cavalerie* 3774 (BM! – lectotype, selected here; E, with *D. lachoongensis*!, K!, P! – isolectotypes).

Dryopteris apicifixa Ching, Boufford & Shing in Bartholomew et al., *J. Arnold Arbor.* **64** (1): 27 (1983). Type: China, western Hubei Province, Shennongjia Forest District (31° 30′N, 110° 30′E), along the trail between Hongriwan construction camp and Quijiaping, 1200–1400 m, 2 September 1980, *1980 Sino-American Botanical Expedition* 543 (PE – holotype; A!, CM, HIB, UC – isotypes).

Fronds medium to large (up to *c.* 110 cm long). Stipe long, up to *c.* ½ the length of the lamina, the very base bearing a tuft of long, narrowly lanceolate, russet-brown scales and the widest part of the base densely clothed with ovate-lanceolate, ± thick, glossy, russet–mid-brown scales, sometimes with very dark brown bases, becoming scattered and smaller further up the stipe, rachis ± glabrous except for a few small, very scattered, very narrow, mid-brown scales. Lamina twice pinnate, a third time deeply pinnatifid below, slightly elongated triangular-lanceolate (up to *c.* 35 cm wide), not tapered below, bearing up to *c.* 20 pairs of ± contiguous pinnae; pinnae elongated triangular-lanceolate, markedly coriaceous, dark green and glossy above, bearing a few very scattered, very small, hair-like, pale scales on the lower surface of the costae, and up to *c.* 18 pairs of ± large pinnules; pinnules long, somewhat wide, stalked near the bases of the pinnae, but becoming broadly attached to the pinna-costae above half-way up, the upper ones unlobed, the lower ones ± deeply lobed with rectangular lobes, which vary from broad and crowded to narrow and somewhat spaced-out, the lowest pinnules sometimes becoming ± pinnatisect, pinnule-lobes ± untoothed, or bearing a few insignificant, acute teeth, pinnule-apices rounded-truncate (rarely becoming ± pointed), bearing prominent, wide-based, ± long-acute teeth around them, pinnules on the basiscopic side of the lowest few pairs of pinnae

Fig. 39 *Dryopteris fructuosa*. Bhutan, Ritang to Ratsoo, 23 April 1967, *H. Kanai et al.* 9975 (BM). Scale line = 1 cm.

frequently developed and longer than those on the acroscopic side. Sori large, tall, often slightly crowded, in two rows, one on each side of the centre of the pinnule, indusiate; indusia markedly curved down and often slightly inflected at the edges, thick, becoming brown, shrivelling slightly, lifting, but mostly persistent. Spores irregular, with fully formed and abortive spores.

Cytology: Triploid apomict (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal* 9, August 1958 (PAN 2232!, 2284!). China: Gibby (1985)).

Ecology: A species of the upper-level forest zone, growing on the ground, often beside rocks in light forest, from *c.* 2200–3600 m alt.

Range: India (E. Himalaya in Sikkim and N. Assam; Assam); Nepal; Bhutan; SE. Tibet; ?N. Burma; China (Yunnan, Szechuan, Kweichow); Taiwan. A Sino-Himalayan species of the widespread sort, though apparently not reaching very far westward in the Indo-Himalaya.

Range in the Indian subcontinent: **57** Shiar Khola, Thumje, 8000 ft (2440 m), 20 June 1953, *P. C. Gardner* 806 (BM!); **58** Phulchowki, Kathmandu valley, 7–9000 ft (2130–2740 m), January–February 1954, *R. L. Fleming* 1592 (bis) (MICH!); **59** Langtang valley, District Rasuwa, 3400 m, 6 November 1977, *V. L. Gurung & party* 77/721 (KATH!); **60** Sur talus rocheux à Phakding, 2600 m, 10 May 1952, *A. Zimmermann* 476 (BM!); **65** Sikkim, 1884, *Burr*, Bootia Collection (E!, K!), and Ryaning above Jongri, 12,000 ft (3640 m), June 1888, *Dr King's collector* (B!), and Rookah, nr Lachung, 11,000 ft (3340 m), May 1885, *G. King's collector* 18281 (CAL!); **67** Tzatogang to Dotanang, 27 May 1967, *H. Kanai et al.* 21866 (BM!); **68** Ritang (2400 m) to Ratsoo (1850 m), 23 April 1967, *H. Kanai et al.* 9975 (BM!, KYO!); **74** Jangda, Tawang, *P.*

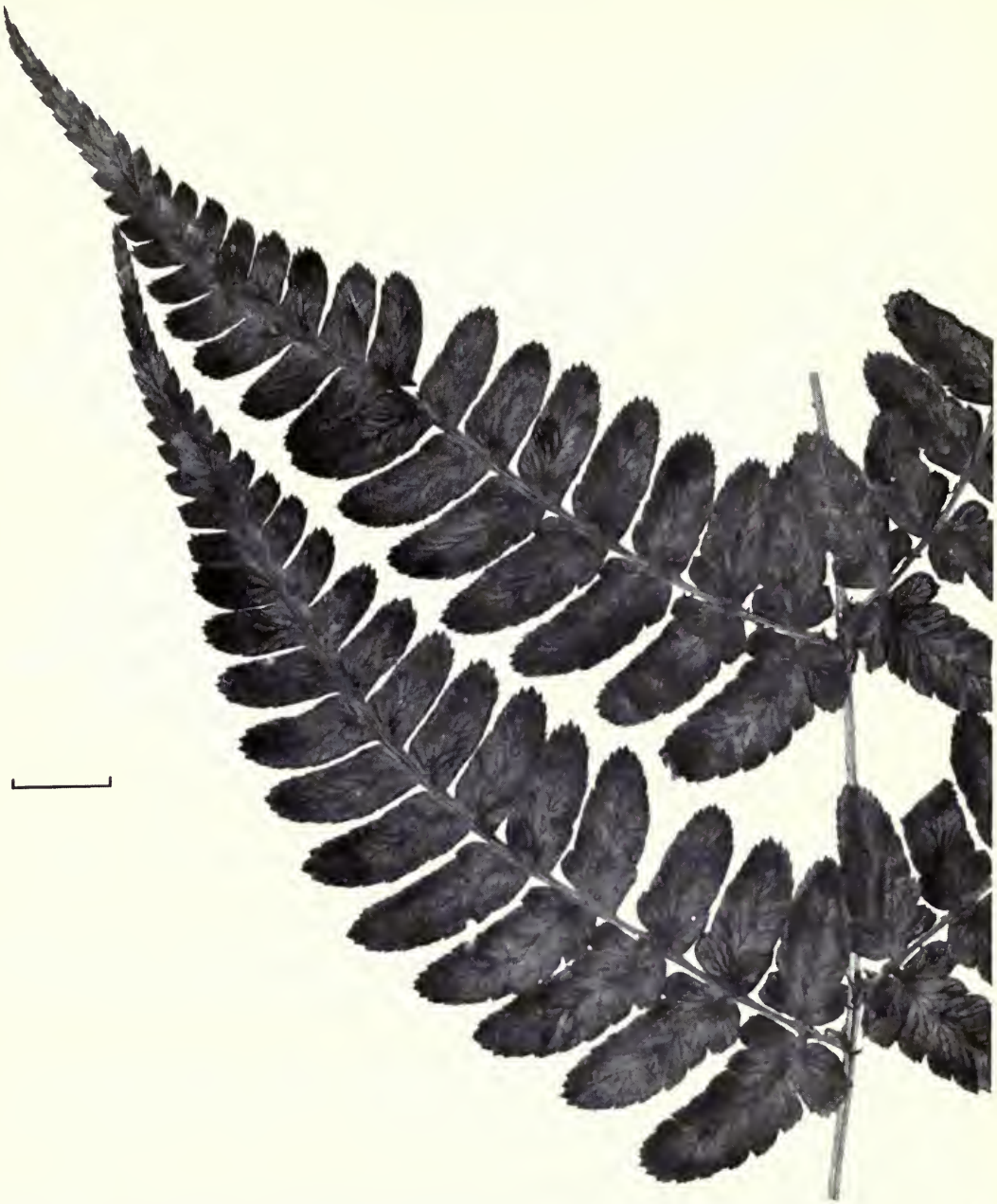

Fig. 40 *Dryopteris fructuosa* (less dissect form). Nepal, Tumje, Shiar Khola, 20 June 1953, *P. C. Gardner* 806 (BM). Scale line = 1 cm.

Chandra 80411 (LWG!), and Kameng, Jabrang Camp area, 2515 m, 3 April 1957, *G. Panigrahi* 6406 (ASSAM!); **79** Kegwima edge, Naga Hills, 7500 ft (2290 m), 10 November 1885, *C. B. Clarke* 41867 (K!).

Notes: Dryopteris fructuosa has been somewhat overlooked as it is uncommon in the Indo-Himalaya and has only been recorded from there by Ching (1938), Loyal in Mehra (1961), Mehra & Loyal (1965), and Itô, Tagawa & Iwatsuki (1966, 1971, sub *D. hypophlebia*). However, there are several collections of it in herbaria, usually in the '*D. odontoloma*' and '*D. marginata*' folders, though it is markedly distinct from either of these. There has also been some

confusion between it and two related but distinct species, *D. lachoongensis* (see under that species) and *D. basisora* Christ. *D. basisora* is apparently confined to Yunnan, Szechuan, and Kansu in China and is distinguished from *D. fructuosa* by its normally less lobed pinnules with wider apices and a slightly contracted area near the bases, the sori being confined to the base of the pinnules; it also has more matt scales and a paler lamina, and is thus slightly intermediate towards *D. sublacera*. Several synonyms placed by Ching (1938) under *D. fructuosa* belong under *D. basisora*, though it has been necessary to select lectotypes to clarify the situation as some of the syntypes of each taxon belong to other species. These names are as follows: *Aspidium varium* var. *obtusum* Christ in *Mém. Soc. bot. Fr.* **1** (1): 43 (1905) – lectotype: China, Ta-Long-Tan près Ta-Pin-Tze [Yunnan], 14 March 1888, *Delavay* 3355 (P!); *Dryopteris fructuosa* var. *integriloba* Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 446 (1938) – lectotype: China, Szechuan, Hweili Hsien, *T. T. Yü* 1559 (sub *D. pandurata* Ching, ined.) (PE!); and *Dryopteris basisora* Christ in Lecomte, *Not. syst.* **1**: 44 (1909) – lectotype: China, Haut Tong Chan, près Yunnan-Sen [Kunming], 10 September 1905, *Ducloux* 57 (P!).

D. fructuosa is a variable species ranging from somewhat less dissect plants with coarse, wide, crowded segments (approaching *D. lachoongensis*), to more dissect plants with more delicate fronds and more widely spaced segments, becoming tripinnate below; there are also plants from exposed places with more or less unlobed pinnules. Christensen (1905) and Ching (1938) separated the more delicate and dissect plants as *D. pseudovaria* (Christ) C. Chr., but these forms do not appear to be of significance and range into each other, as can readily be seen both in the field and with plants in cultivation, which can vary from year to year according to conditions. From the material at PE placed by Ching under *D. fructuosa*, it is clear that his concept of *D. fructuosa* was mainly *D. basisora*, which explains why he separated *D. pseudovaria* as a distinct species. A specimen of *D. pseudovaria* selected by Ching (1938) as the lectotype was not part of the original material cited by Christ and cannot now be traced. It is therefore replaced by the lectotype cited above.

D. fructuosa has been recorded from Taiwan under the name *D. hypophlebia*, though this name was later confused by Ching (1938: 479), partly in error for *D. assamensis* from Kwangtung, China. Ching considered *D. hypophlebia* to be closely related to *D. fuscipes* C. Chr. (subgenus *Erythrovariae* (Fraser-Jenkins, 1986)), on the basis of a photograph in his possession (copy in IBSC!), purporting to be of the type specimen of *D. hypophlebia*, but actually of a small specimen of *D. lepidopoda*, superficially very close to *D. fuscipes*.

Section 7. Splendentes Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 193 (1986).

37. Dryopteris splendens (Hook.) Kuntze **Fig. 41**

Revis. gen. pl. **3**: 813 (1891). – *Nephrodium splendens* Hook., *Sp. fil.* **4**: 126 (1862). – *Lastrea splendens* (Hook.) Beddome, *Ferns Brit. India* **1**: 42, pl. 42 (1865). – *Aspidium splendens* (Hook.) Christ, *Farnkr. Erde*: 259 (1897), nom. illeg. (Art. 64.1), non Willd. (1810). Type: India, Sikkim, *J.D.H.* [*Hooker*] (K! – lectotype, selected here; BM!, E!, K! – isolectotypes).

Misapplied name: Dryopteris reflexosquamata sensu Itô, Tagawa & Iwatsuki (1966).

Fronds very large (up to *c.* 180 cm long), arising in a crown from a very thick rhizome. Stipe ± long, *c.* ⅓ the length of the lamina, very thick, widened at the base, glossy-black or very dark castaneous-brown, with a pale, raised ridge on either side of the widened part of the base, bearing scattered, somewhat small, ± thin, adpressed, mid-brown, ovate-lanceolate scales, which become considerably more scattered further up the stipe, rachis black, becoming pale green near the apex, bearing a few scattered, small, adpressed, lanceolate, dark brown scales. Lamina twice pinnate, lanceolate to ovate-lanceolate (up to *c.* 50 cm wide), very slightly tapering below to a widely truncate base, bearing up to *c.* 32 pairs of distant pinnae; pinnae with black costae, narrowly lanceolate, somewhat thickly herbaceous, dark green above, paler below, ± glabrous, bearing many (up to *c.* 28 pairs) large pinnules; pinnules long, ± oblong-lanceolate, narrowed slightly at their bases but attached to the pinna-costae somewhat widely, becoming fully adnate further up the pinnae, somewhat deeply lobed with ± rectangu-

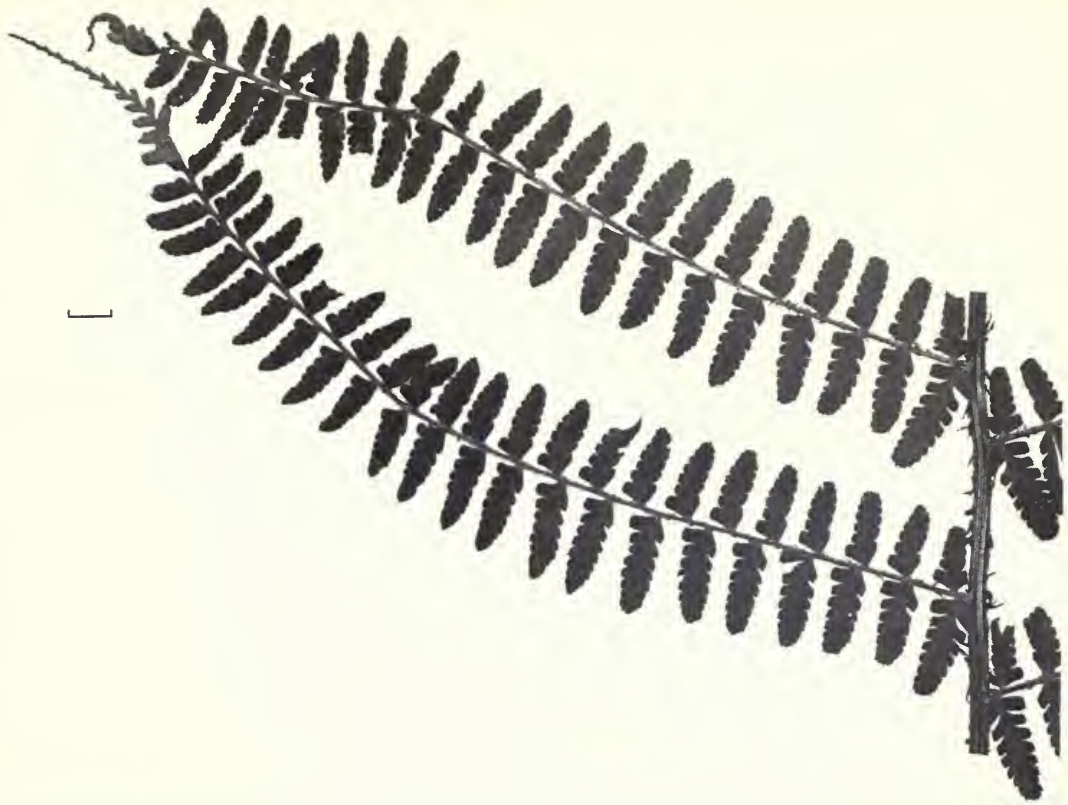

Fig. 41 *Dryopteris splendens*. India, West Bengal, Darjeeling, Gairibas to Tonglo, 16 November 1978, *C. R. Fraser-Jenkins* 8531 (BM). Scale line = 1 cm.

lar, somewhat wide, contiguous lobes, with ± truncate apices, lobes markedly longer and wider on the acroscopic side of the pinnule and more obliquely sloping on the basiscopic side, ± without teeth or with one or two small, insignificant, acute teeth, pinnule apices rounded or obtusely pointed, bearing somewhat wide, acute-tipped teeth. Sori large, not crowded, in two rows, one on each side of and near to the centre of the pinnule, indusiate; indusia tall, curved down at the edges but not inflected below, thick, lifting, becoming mid-brown and shrivelling somewhat, but mostly persistent. Spores regular.

Cytology: Diploid sexual (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), specimens cited without locality, date, etc., *D. S. Loyal*, August 1954 (PAN 1184!, 1185!, 1187!) and *D. S. Loyal* 35, August 1955 (PAN 1186!)).

Ecology: A species of the mid- to upper-level forest zone, growing on the ground in dense forest, often near streams, from *c.* 2500–3000 m alt.

Range: India (E. Himalaya in Sikkim and N. Assam; Khasia); E. Nepal; Bhutan. A Sino-Himalayan species of the east Himalayan sort. Reported in error from Malaya (Clarke, 1880; Beddome, 1883; Ching, 1938; etc.) on the basis of a specimen at Kew (!) labelled 'Malayan Peninsula. *Sir W. Norris*', many of Norris's specimens of Himalayan ferns being incorrectly labelled as from Malaya.

Range in the Indian subcontinent: **62** Upper Mewa Gorge, 8200 ft (2500 m), 7 December 1971, *R. L. Fleming* 2134 (K!, MICH!), and Milke pass, 9500 ft (2890 m), 20 July 1971, *T. B. Shresta & D. P. Joshi* 156 (KATH!); **63** West of Bhanduky Bhanjyang, 8800 ft (2680 m), 28 September 1978, *R. L. Fleming* 2639 (BM!, MICH!); **64** East facing slope, Gairibas to Tonglo, lower Singalilla ridge, west of Darjeeling on road to Sandakphoo, 9500 ft (2890 m), 22 October 1980, *C. R. Fraser-Jenkins* 10366 (BM!); **65** Sikkim

Himalaya, May 1875, *Dr Treutler* 854 (K!); **67** Bhotan, *W. Griffith* (B!, K!) and Bhutan Hills, *C. J. Simons* (BM!); **74** Chakoo, Kameng, 1957, *G. Panigrahi* 6331 (CAL!); **83** Khasiya, *H[ooker] & T[homson]* (BM!).

Notes: Dryopteris splendens is replaced in Yunnan, China by a distinct, more narrowly dissect species, *D. rubripes* Ching & Chu in prep., which is intermediate between *D. splendens* and *D. sikkimensis*. This has been reported by Beddome (1892) as *D. splendens*, and by Ching (1938) as *D. sikkimensis* in error, which explains Ching & Wu's (1983) subsequent redescription of true *D. sikkimensis* from SE. Tibet as *D. pseudo-sikkimensis* Ching & S. K. Wu. Ching (pers. comm. 1982) later accepted the latter as being identical to *D. sikkimensis*, following correspondence with the author, who pointed out the distinctness of *D. sikkimensis* sensu Ching (1938).

38. Dryopteris sikkimensis (Beddome) Kuntze **Fig. 42**

Revis. gen. pl. **2**: 813 (1891). – *Polystichum sikkimense* Beddome, *Ferns Brit. India* **1**: 127, pl. 127 (1866). – *Aspidium sikkimense* (Beddome) Baker in Hook. & Baker, *Syn. fil.*: 256 (1867). – *Lastrea sikkimensis* (Beddome) Beddome, *Handb. ferns Brit. India*: 259 (1883). Type: India, near Lepcha, [Sikkim], 10–11,000 ft, *T. Thomson* (K! – lectotype, selected here; CAL!, K!, MICH! – isolectotypes).

Dryopteris pseudo-sikkimensis Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 267, fig. 64, 3–5 (1983). Type: Tibet, Mao To, 2300 m, 3 August 1974, *S. K. Wu* 4011 (PE! – holotype).

Fronds medium to large (up to *c.* 80 cm long). Stipe long, *c.* ½ the length of the lamina, slightly thick, glossy, reddish near the base, becoming paler above and on the rachis, the base bearing dense ovate-lanceolate, thin, glossy, black scales, which become somewhat smaller, narrower and more scattered further up, but remain somewhat large and wide, including those on the rachis where there are prominent tufts of ± large, dark scales at the points of insertion of the pinna-costae. Lamina twice pinnate, a third time deeply pinnatifid, widely lanceolate (up to *c.* 30 cm wide), not, or only very slightly tapering below to a widely truncate base, bearing up to *c.* 20 pairs of markedly distant pinnae; pinnae markedly narrowly linear-lanceolate with caudate apices, somewhat coriaceous or crispaceous, mid-green above, the costae bearing scattered, small, narrow, mid- to dark brown scales on the lower surface, bearing many (up to *c.* 18 pairs) ± large pinnules; pinnules somewhat long, ± oblong-lanceolate, ± narrowly attached at their bases, markedly deeply lobed into long, ± rectangular, narrow, ± well-separated lobes, which are markedly longer on the acroscopic side of the pinnules and narrower and more obliquely sloping on the basiscopic side, bearing several narrowly acute teeth around them, lobe apices markedly acutely pointed, pinnule-apices obtusely or acutely pointed. Sori somewhat small, confined to the apical third of the pinnules, not crowded, in two rows, one on each side of the centre of the pinnule, midway between the centre and the margins, indusiate; indusia slightly curved over the sorus, thin, lifting, becoming brown, shrivelling markedly and mostly deciduous. Spores regular.

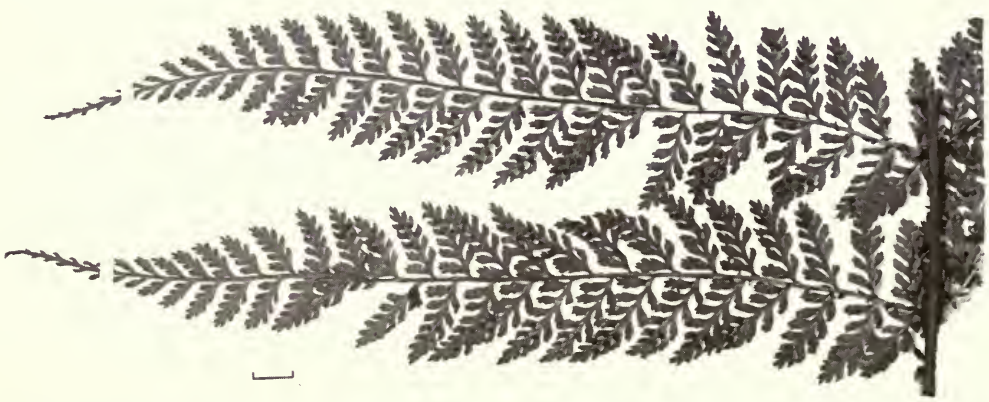

Fig. 42 *Dryopteris sikkimensis*. India, Sikkim, Jongri, 15 October 1875, *C. B. Clarke* 25985 (BM). Scale line = 1 cm.

Cytology: Unknown.

Ecology: A species of the upper-level forest zone, growing on the ground in light forest, from *c.* 3000–3600 m alt.

Range: India (E. Himalaya in Sikkim); SE. Tibet. A rare Sino-Himalayan species of the east Himalayan sort.

Range in the Indian subcontinent: **65** Karponang, 10,000 ft (3040 m), September 1955, *D. S. Loyal* (PAN 1196!), and Jongri, 12,000 ft (3640 m), 15 October 1895, *C. B. Clarke* 25972e (BM!, P!). Apparently confined to North Sikkim, though it may perhaps be expected in adjacent areas.

Notes: Dryopteris sikkimensis has been reported from Yunnan, China, by Ching (1938) in error for an undescribed species (about to be published as *D. rubripes* Ching & Chu), which is nearer to *D. splendens*, though somewhat intermediate between the two (see under *D. splendens*). The narrow, pointed lobes in *D. sikkimensis* have caused it to be confused with the genus *Polystichum* and its segment-shape bears a superficial resemblance to that of *P. thomsonii* (Hook.) Beddome, though it has a much larger and wider frond. It could also be confused with the much more dissect *Lithostegia foeniculacea* (Hook.) Ching, but differs from this species in its scale and indusial characteristics. Despite its distinctive features, *D. sikkimensis* is obviously related to *D. splendens* and other species in the section *Splendentes*.

Section 8. Marginatae Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 194 (1986).

39. Dryopteris cochleata (Buch.-Ham. ex D. Don) C. Chr. **Figs 43–44**

Index filic.: 258 (1905). – *Nephrodium cochleatum* Buch.-Ham. ex D. Don, *Prodr. fl. nepal.*: 6 (1825). – *Lastrea cochleata* (Buch.-Ham. ex D. Don) T. Moore, *Index fil.*: 88 (1858). – *Nephrodium filix-mas* var. *cochleatum* (Buch.-Ham. ex D. Don) Hook., *Sp. fil.* **4**: 116 (1862). – *Lastrea filix-mas* var. *cochleata* (Buch.-Ham. ex D. Don) Beddome, *Suppl. ferns S. Ind.*: 33 (1876). – *Aspidium filix-mas* var. *cochleatum* (Buch.-Ham. ex D. Don) Christ, *Farnkr. Erde*: 257 (1897). – *Aspidium cochleatum* (Buch.-Ham. ex D. Don) Christ in *Bull. Herb. Boissier* **6**: 967 (1898). – *Dryopteris filix-mas* var. *cochleata* (Buch.-Ham. ex D. Don) Alderw., *Malayan ferns*: 193 (1909). Type: Nepal, Hettaura, 3 April 1802, *Dr Buchanan* (BM! – lectotype, selected here).

Arthrobotrys macrocarpa Wallich, *Num. list*: no. 395 (1828), nom. nud. (Art. 32.1). – *Lastrea macrocarpa* C. Presl, *Tent. pterid.*: 77 (1836), nom. nud. (Art. 32.1). Specimens in BM!, K!, K-W!, etc.

Arthrobotrys avana Wallich, *Num. list*: no. 1034 (1828), nom. nud. (Art. 32.1), Specimens (from Ava Montes) in K!, K-W!, etc.

?*Aspidium erythrosorum* var. *souliei* Christ in *Mém. Soc. bot. Fr.* **1** (1): 40 (1905), teste Ching (1938). Type: 'Thibet or.: Tsé-kou, Haut-Mékong, *Soulié* (1895), s.n.' (P? – the present author could find only an abnormal, foliose specimen of *Dryopteris juxtaposita* in P, without a name, but with the following data: 'Thibet Oriental, Tongolo, Principauté de Kiala, Tsé-kou (Haut Mekong). *J.-A. Soulié*, 1895').

Dryopteris heleopteroides Christ in *Philipp. J. Sci.* (Bot.) **2**: 212 (1907). Type: Philippines, Bued river, Benguet, *E. B. Copeland* 1837a (B!, excluding a small specimen of *Dryopteris chrysocoma* on the same sheet – lectotype, selected here; MICH! – isolectotype).

Fronds dimorphic, the *sterile ones* large (up to *c.* 110 cm long), forming an arching basket from a thick, creeping rhizome with an ascendent apex. Stipe thick, smooth, long, *c.* ⅔ as long to the same length as the lamina, ± densely scaly at the base with large, lanceolate, thin, pale- to mid-brown scales, which are absent from the upper parts of the stipe and rachis apart from a few scattered, very small, hair-like ones which also occur on the pinna-costae and are mostly deciduous later. Lamina twice pinnate, triangular-lanceolate (up to *c.* 50 cm wide), with a widely truncate base, bearing up to *c.* 22 pairs of contiguous, or overlapping pinnae; pinnae lanceolate, herbaceous, smooth and pale- to mid-green above, ± glabrous, bearing many (up to *c.* 20 pairs) large pinnules; pinnules markedly longer than wide, with their bases widely attached to the pinna-costae, joined together at their bases by a narrow wing of laminar tissue, but becoming more narrowly attached to the costae near the bases of the pinnae, the lowest ones on each pinna usually being stipitate, though a very narrow wing of laminar tissue extends around the stalk and along the pinna-costae between the pinnules, pinnules lanceolate, unlobed, or with shallow,

Fig. 43 *Dryopteris cochleata* (sterile frond). India, Himachal Pradesh, Dehra Dun to Chandigarh, Paonta Sahib, Nakan, 20 October 1978, *C. R. Fraser-Jenkins* 8136 (BM). Scale line = 1 cm.

rounded lobes in the lower pinnules of lower pinnae, pinnule-apices obtusely pointed or sometimes becoming somewhat acutely pointed, bearing a few acute teeth. *Fertile fronds* differing from the sterile ones in being upright with a very long stipe, the same length as the lamina or up to about twice as long. Lamina lanceolate (up to *c.* 12 cm wide), with a truncate base; pinnae distant; pinnules contracted, ± crowded, thick in texture, ± parallel-sided with rounded apices, bearing a few narrowly-acute teeth with acuminate apices around the pinnule-apices and upper parts of the pinnule-margins. Sori tall, markedly large, in two rows, one on each side of the pinnule-centre, markedly crowded and covering more or less the whole lower surface of the pinnule, indusiate; indusia curved down at the edges but not surrounding the base of the sorus, thick and fleshy, greenish-white, with the dark colour of the sporangia showing through, becoming brown, lifting and shrivelling slightly, but persistent. Spores regular.

Cytology: Diploid sexual (W. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal*, August 1953 (PAN 3114!) and *T. C. Mittal*, October 1957 (PAN 1341!). Mehra & Khullar (1980), voucher specimens, *S. P. Khullar* 52, October 1965 (PAN 5414!) and *S. P. Khullar* 172, September 1967 (PAN 6057!, 6058!). Nepal: Roy & Sakya in

Fabbri (1963). Roy, Sinha & Sakya (1971). East Indian plains (Parasnath): Roy & Pandey in Fabbri (1963). S. India: Bhavanandan (1968, 1981).

Ecology: A species of lower-level forests and shaded banks, growing on the ground, from *c.* 300–2000 m alt.

Range: India (central and eastern parts of the W. Himalaya; E. Himalaya in Sikkim and N. Assam; Assam; mountain ranges of the west, central, and east Indian plains in Madhya Pradesh, Bihar, and Orissa; west and east Indian peninsula; S. India); Nepal; Bhutan; Bangladesh; Burma; China (Yunnan, Szechuan, Kweichow); Thailand; N. Vietnam; Java; Bali; Timor; Philippines. A south-east Asian element, but apparently absent from Sri Lanka.

Range in the Indian subcontinent: **32** Chamba to Lahoul, 9–10,000 ft (2740–3040 m), August–September 1891, *E. L. Forrester-Brown* (BM!); **33** 9 km south of Dalhousie, Ravi valley, 800 m, 30 August 1977, *C. R. Fraser-Jenkins* 6619, 6620 (BM!); **34** Near Mandi, 2 August 1952, *E. Schelpe* 3658 (BM!); **35** Parbatti valley, Kulu District, 20 July 1952, *E. Schelpe* 3636 (BM!); **37** 9 km east of Dagshai on Nahan road, south of Simla, 1550 m, 9 September 1977, *C. R. Fraser-Jenkins* 7071 (BM!), 7074 (PE!), 7070, 7075 (Herb. T. Reichstein, Basel!); **39** Jaunsar, 6000 ft (1830 m), October 1894, *J. F. Duthie* 15778 (K!); **40** Hill west of Rajpur, Dehra Dun, 3150 ft (960 m), 13 November 1884, *C. W. Hope* (BM!, K!); **42** Garhval [Garhwal], Gobeser [Gopeswar] to Okimath, from Alaknanda to the Mandagni [Mandakini] valley, 5000–6800 ft (1520–2070 m), 14–16 September 1855, *G. Schlagintweit* 8826 (B!); **43** 10 km south of Joshimath, north-east of Rishikesh, Alaknanda valley, 1400 m, 17 September 1977, *C. R. Fraser-Jenkins* 7237 (BM!); **45** Bharadi to Loharkhet road, Pindari, 1200 m, October 1965, *S. P. Khullar* 52 (PAN 5414!); **46** Almoora (DD!); **47** Thal, 1200 m, September 1967, *S. P. Khullar* 172 (PAN 6057, 6058!); **48** Gangolihat, 5000 ft (1520 m), 28 September 1891, *E. W. Trotter* (RAW!); **52** Kuibandanda, Babai, 25 February 1976, *K. J. Malla, R. J. Shah & P. R. Sharma* 893 (KATH!); **55** Andhi Khola, 3000 ft (910 m), 2 October 1954, *J. D. A Stainton, W. R. Sykes & L. H. J. Williams* 8719 (BM!, E!); **56** Hathikot, Palpa District, 900 m, 28 February 1974, *D. P. Joshi & M. M. Amatya* 74/1288 (KATH!); **58** Tiger top, Chitwan, 300 m, 12 December 1974, *D. P. Joshi, I. Brajacharya & R. Kayastha* 75/3489 (KATH!); **59** Langtang, distr. Rasuwa, on way to Shyapruberi from Bhasgu, 1465 m, 1 October 1977, *V. L. Gurung & party* 77/651 (KATH!); **61** Ranga Pani–Chisa Pani–Lookya Mai–Ghorwa, 9 December 1963, *H. Hara et al.* 6305248 (BM!); **63** Ilam, 28 September 1971, *D. P. Joshi* 55 (KATH!); **64** Below Kalimpong, 8 November 1879, *J. S. Gamble* 7292 (K!); **65** Tuckvar, herb. *Treutler* C.P. 799 (K!); **67** Bootan, *W. Griffith* 2774 (BM!, K!); **73** Singbum, West Duars, *H. H. Haines* 277, 487 (CAL!, K!); **79** Kohima, 5000 ft (1520 m), 20 October 1885, *C. B. Clarke* (K!); **80** Manipur, 1881–2, *G. Watt* 7471 (K!); **81** South Lushai, 3500 ft (1070 m), November 1931, *Rev. Wenger* 393 and June 1928, *Rev. Wenger* (K!); **83** Khasya, *T. Lobb* (K!); **87** Pachmarhi, 24 February 1891, *J. F. Duthie* 10678 (K!), and streams near Khara, Balaghat, February 1911, *H. H. Haines* 5867 (K!); **88** Parasnath, 2000 ft (610 m), 17 November 1874, *C. B. Clarke* 24883A, 24850 (K!), and Icha Dag, Ranchi District, 2500 ft (760 m), 31 August 1918, *H. H. Haines* 4431 (K!); **90** Chittagong, *J. D. Hooker & T. Thomson* 556 (K!); **91** Mahabuleshwar, 1885, *Col. Bates* (K!); **92** North Kanara and Karnatak (CAL!); **93** Neelgherries [Nilgiris], February 1838, *Viscount Gough* 3267 (14) (K!); **94** Anamallay, teak forests, 2500 ft (760 m), *R. H. Beddome* (K!); **95** Stream 24 km north of Kodaikanal on Palni road, north side of Palni Hills, 1700 m, 19 December 1978, *C. R. Fraser-Jenkins* 9137 (BM!); **96** Vizagapatnam district, Chitticherla, 2000 ft (610 m), January 1890, *J. S. Gamble* 21808 (K!); **98** Roadside west of Yercaud, Shevaroy Hills, north-east of Salem, west of Madras, *c.* 1400 m, 13 December 1978, *C. R. Fraser-Jenkins* 9025, 9026 (BM!), 9027–9034, 9036 (H!); **99** Prov. Trivandrum, Ponmudi, 1000 m, 29 September 1973, *C. D. K. Cook, E. M. Rix & J. J. Schneller* 365 (Z!). Also, unlocated: Raitt Berar and Brumagherries (BM!) and Madras, Billigirirangan Hills, 5000 ft (1520 m), September 1938, *E. Barnes* 517 (MICH!).

Notes: Ching (1938) cites a Wallich specimen (no. 395) as the type of *Dryopteris cochleata*, following Don, who cited both a Hamilton and a Wallich collection. However, Ching's citation cannot be regarded as lectotypification as a very great number of Wallich specimens were distributed widely under the number 395, and sometimes contained mixed gatherings. No indication was made as to which specimen was intended. The single Hamilton specimen that Don cited in detail is therefore selected here as the lectotype.

Dryopteris cochleata is at the edge of the section *Marginatae*, with some similarities to some members of the section *Pandae*. However, its wider and more dissect lamina show it to be a somewhat undissect member of the *Marginatae*. It is a markedly distinct and easily recognisable species, though earlier authors occasionally confused it with the much narrower-fronded *D.*

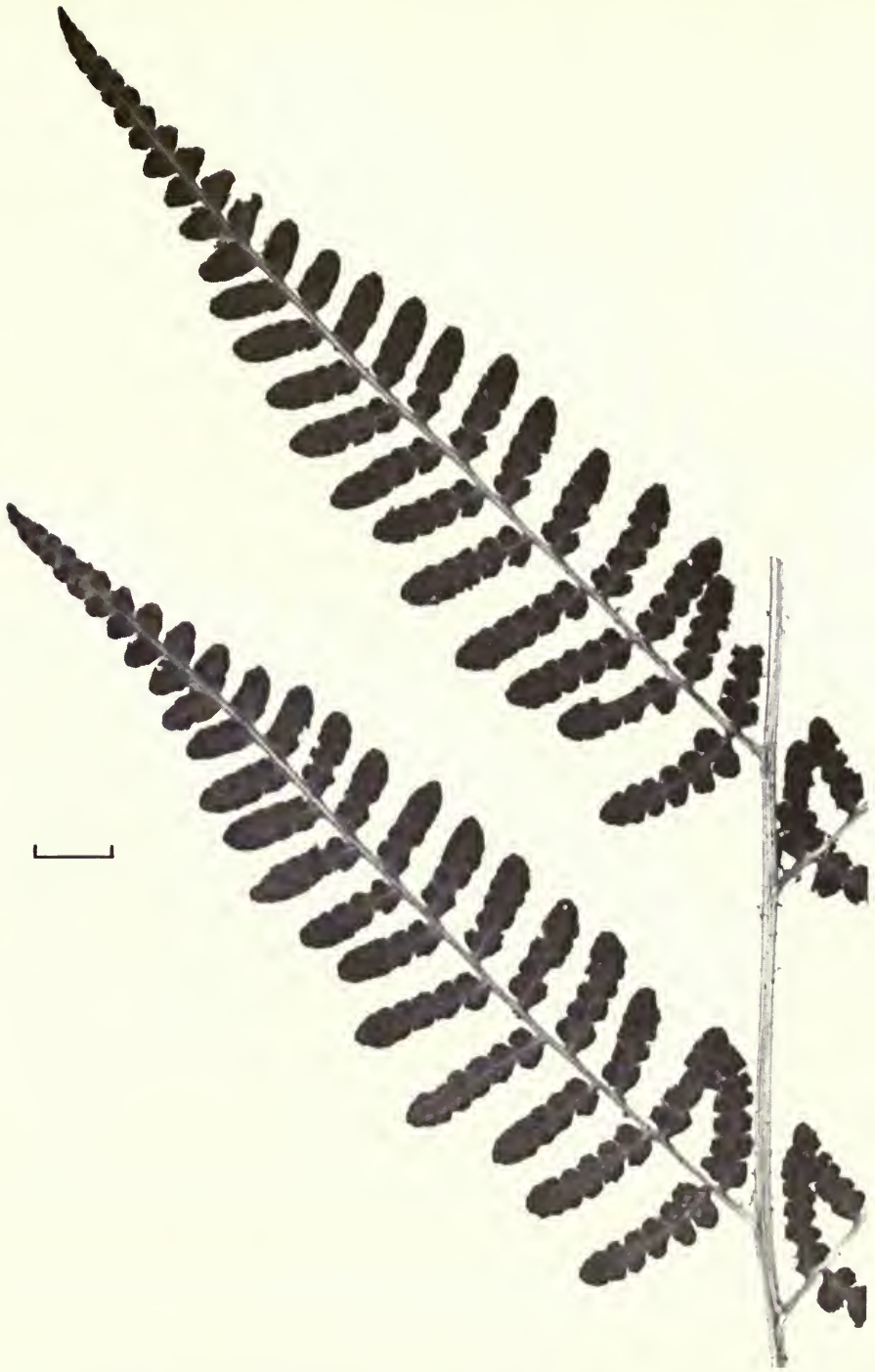

Fig. 44 *Dryopteris cochleata* (fertile frond). India, Himachal Pradesh, Dehra Dun to Chandigarh, Paonta Sahib, Nakan, 20 October 1978, *C. R. Fraser-Jenkins* 8136 (BM). Scale line = 1 cm.

chrysocoma, as both have large sori. Sterile fronds could possibly be confused in herbaria with *D. marginata* or *D. caroli-hopei*, but are less dissect. Some plants may produce occasional semi- or more or less uncontracted fertile fronds (e.g. some collections from the Shevaroy Hills, south India and occasionally from elsewhere) which have caused confusion, but in all other respects such fronds are perfectly normal. However, in parts of south-east Asia (e.g. Bali), as well as normal ones, plants occur which are completely non-dimorphic and the uncontracted fertile fronds appear more or less similar to *D. caroli-hopei* but with large, tall sori.

In the Himalaya, towards the end of the season, *D. cochleata* is particularly prone to infestation by small moth-larvae which eat the sporangia and leave large masses of damaged soral material on the lower surfaces of the fronds, in which they pupate. Other species are also infected, but to a lesser extent. The resulting spore fragments in samples examined under the microscope may suggest that the spores are partly abortive. However, these fragments are not like true abortive spores. Spore dispersal in this species has been investigated by Loyal (1981, 1985).

40. Dryopteris pteridiiformis Christ **Fig. 45**

in *Bull. Acad. int. Géogr. bot.* **17**: 137–138 (1907). Type: China, environs de Yun-Nan Sen, ravin, près des eaux, 20 December 1905, *F. Ducloux* 95 (P! – lectotype, selected here; BM!, E!, PE! – isolectotypes).

Fronds ± large (up to *c.* 100 cm long), normally with about two or three fronds arising from the apex of a creeping, branched, ± underground, thick rhizome; fertile fronds somewhat taller and more upright than sterile ones. Stipe long, about the same length as the lamina, pale green with a brown base, thick; the base bearing somewhat scattered, large, pale, thin, ovate, adpressed scales, which become very scattered or ± absent, smaller and slightly narrower further up. Lamina somewhat thick, twice pinnate, becoming a third time deeply pinnatifid below or, in large fronds, a third time pinnate, narrowly triangular-lanceolate (up to *c.* 45 cm wide), not, or hardly, tapered below to a truncate base, bearing up to *c.* 20 pairs of normally somewhat distant pinnae; pinnae narrowly triangular-lanceolate, becoming lanceolate in the upper part of the lamina, herbaceous, pale green and matt above, ± glabrous, bearing up to *c.* 15 pairs of large pinnules; pinnules long, lanceolate, widely attached to the pinna-costae near the tips of the pinnae, but sloping to their cuneate bases and narrowly attached elsewhere, becoming stalked at their bases towards the bases of the lower pinnae, varying from almost unlobed to deeply pinnatifid, but just becoming pinnatisect in the lower pinnules of the lowest pinnae in large and well-developed plants, lobes somewhat distant, with ± straight, sloping sides and truncate apices which bear a few long-acute teeth, pinnule-apices ± obtusely pointed, bearing long-acute teeth, pinnules on the basiscopic side of the lowest few pairs of pinnae usually becoming slightly developed and slightly longer than those on the acroscopic side. Sori somewhat large, not, or only slightly crowded, in two rows, one on each side of the centre of the pinnule near to the centre, some of the larger lowest lobes in lower pinnules themselves bearing two short rows of two sori, indusiate; indusia ± large, ± flat or very slightly curved down at the edges, ± thin, becoming brown, lifting and shrivelling considerably, mostly falling off later. Spores regular.

Cytology: Tetraploid (China: Gibby (1985)).

Ecology: A species of the mid-level forest zone, growing on the ground, often by stream banks and at the edges of the forest, from *c.* 1800–2300 m alt.

Range: India (Assam); ? N. Burma; SW. China (Yunnan). A Sino-Himalayan species of the east Himalayan sort.

Range in the Indian subcontinent: **79** Takubama, Naga Hills, 7000 ft (2130 m), 4 August 1950, *T. Rup Chand* 3383 (MICH!, US!).

Notes: Dryopteris pteridiiformis is reported here for the first time from the Indian subcontinent, where it is known from only one collection. It is less dissect than most other species in the section *Marginatae* and is presumably near the edge of the section, though clearly related to other

Fig. 45 *Dryopteris pteridiiformis*. China, Yunnan, Kunming, northern Zhi Shan, 17 April 1980, *C. R. Fraser-Jenkins, W. M. Chu & S. K. Wu* 10024 (BM). Scale line = 1 cm.

species within it. It has several features in common with *D. angustifrons*, such as its somewhat narrow frond and completely prostrate rhizome bearing few fronds, though they are not so developed as in that species. It could possibly be an allopolyploid species derived partly from *D. angustifrons* and partly from a less dissect species, perhaps *D. subimpressa* or even *D. cochleata*. Investigation of its genome homologies is therefore desirable.

41. Dryopteris angustifrons (Hook.) Kuntze **Fig. 46**

Revis. gen. pl. **2**: 812 (1891). – *Nephrodium splendens* var. *angustifrons* Hook., *Sp. fil.* **4**: 126 (1862). – *Nephrodium angustifrons* (Hook.) Baker in Hook. & Baker, *Syn. fil.*: 283 (1867). – *Lastrea angustifrons* (Hook.) Beddome, *Ferns Brit. India* **2**: 226, pl. 226 (1867), nom. illeg. (Art. 64.1), non (Mett. ex Kunze)

T. Moore (1858). Type: Nepal, *Wallich* [1821], Herb. Thomas Moore (K! – lectotype, selected here; B!, BM!, K!, P! – isolectotypes).

Fronds large (up to *c.* 90 cm long), arising rather remotely from a ± thin, creeping, black rhizome below the ground surface. Stipe long, about the same length as the lamina, somewhat thin, pale green with a very dark brown base, but tending to become mostly dark brown in many

Fig. 46 *Dryopteris angustifrons*. Nepal, [Kathmandu valley], *Wallich*, Herb. Hooker & Thomson 260 (K – isolectotype). Scale line = 1 cm.

specimens, the base bearing somewhat scattered, pale, thin, ovate, or ovate-lanceolate scales which become very scattered or ± absent, smaller and slightly narrower further up. Lamina three times pinnate, narrowly triangular-lanceolate (up to *c.* 20 cm wide), not, or hardly, tapered below to a truncate base, bearing up to *c.* 18 pairs of ± distant pinnae; pinnae triangular-lanceolate, becoming narrowly triangular-lanceolate in the upper part of the lamina, inserted obliquely and pointing upwards, herbaceous, pale green and smooth above, ± glabrous, bearing up to *c.* 15 pairs of ± large pinnules; pinnules long, triangular-lanceolate, stalked, pinnate near their bases but deeply pinnatifid above, pinnule-apices obtusely pointed, bearing a few small, insignificant, acute teeth, pinnules on the basiscopic side of the lowest few pairs of pinnae usually becoming developed and slightly longer than those on the acroscopic side; pinnulets or pinnule-lobes markedly small, ± crowded, markedly rectangular and parallel-sided, with truncate or rounded-truncate apices, without teeth, or bearing one or two small, acute teeth, mainly at the corners facing towards the pinnule-apices. Sori small, not, or only slightly, crowded, in two short rows, one on each side of the centre of each pinnulet or pinnule-lobe, usually nearer the margins than the centre, indusiate; indusia ± flat, or only very slightly curved down at the edges, thin, becoming brown, lifting and shrivelling considerably, mostly falling off later. Spores regular.

Cytology: Unknown.

Ecology: Presumably a species of the lower mid-level forest zone, growing on the ground, from *c.* 1200–2000 m alt.

Range: Nepal; India (E. Himalaya in Sikkim); China (southern Yunnan); ? N. Burma. A very rare Sino-Himalayan species, probably of the east Himalayan sort.

Range in the Indian subcontinent: **58** 'Napalia', 1821 [*Wallich*] (K!); **65** Sikkim Himalaya, May 1875, *Dr Treutler* (K!).

Notes: This very rare and little-known species appears to be known only from Wallich's original collection, one collection from Sikkim, and one collection of four very good quality sheets from southern Yunnan, near the Burmese border, recently identified by the present author in the Department of Biology and Agriculture of Yunnan University, Kunming (YUKU!), and labelled 'Dryopteris pteridiiformis, S. Yunnan, Meng Hai, 1200 m, 2 July 1976, *Chu, W.-M.* 6788'.

It has been reported from Burma by Dickason (1946), but material has not been seen by the present author and confusion with other members of the section *Marginatae* cannot be ruled out; indeed, the record is probably based on Ching's erroneous record. Ching (1938) reports a Meebold specimen of it from Burma (actually from Manipur), but this specimen (K!) is merely *D. caroli-hopei* with somewhat small and undissect pinnules, as occasionally occurs, particularly in Assam. It is labelled 'Lastrea sparsa Don, Manipur, the Naga Hills and Burma: Maothana 5000 ft. *A. Meebold* 4799, Feb 1906. D. angustifrons, det. *R. C. Ching* 1930'. A duplicate specimen with the same number is in Berlin (!), labelled 'Maothana, Manipur', and is also *D. caroli-hopei*. A further specimen collected by Ducloux (no. 559) from Yunnan, cited by Ching (1938) has not been seen by the author, but is assumed to be doubtful. A few pinnae labelled 'Lastrea boryana. N. Himalayas. W. Cattell, June 1876. ? near angustifrons, det. C. B. Clarke', at Kew (!), are again *D. caroli-hopei*. Despite the wide distance between its known localities the range of *D. angustifrons* is probably comparatively normal and it is hoped that it may be found in areas between the two localities, such as Yunnan or Assam, and refound in Nepal.

42. Dryopteris subimpressa Loyal **Fig. 47**

in *Nova Hedwigia* **16** (3–4): 467, pls 177 and 178 (1969 ['1968']). – Loyal in Mehra, *Res. Bull. Panjab Univ.* II, **12** (1–2): 153 (1961), nom. nud. (Art. 32.1). – Loyal in Mehra & Loyal, *Caryologia* **18** (3): 468, pls 12 and 13 (1965), nom. inval. (Art. 36.1). Type: India, Beri Road, Darjeeling, 7000 ft, rare, 21 July 1957, *D. S. Loyal* 709 (PAN 2179! – holotype; PAN 4348!, 4349!, 4350!, 4351! – isotypes; PAN 2236! (*D. S. Loyal* 5, 1958), PE! ([*D. S. Loyal*, field no.] 3) – presumed isotypes).

Dryopteris subodontoloma Loyal in Mehra, *Res. Bull. Panjab Univ.* II, **12** (1–2): 153 (1961), nom. nud. (Art. 32.1). Specimens: as for *D. submarginata* Loyal.

Dryopteris submarginata Loyal in Mehra & Loyal, *Caryologia* **18** (3): 473, pls 18 and 19 (1965), nom. inval. (Art. 36.1) and illeg. (Art. 64.1), non Rosenstock (1914). – Loyal in *Nova Hedwigia* **16** (3–4): 465, pls 175 and 176 (1969 ['1968']), nom. illeg. (Art. 64.1), non Rosenstock (1914). Type: India, near Lachen, N. Sikkim, 8000 ft, July 1958, *D. S. Loyal* (PAN 2532! – holotype; PAN 2527!, 2528!, 2529! – isotypes). Further specimens from the same gathering, but not cited in the protologue, are PAN 2530–2532!, *D. S. Loyal* 6, July 1958 (PAN 2237!), and [*S. S. Bir*, field no.] 8 (PE!).

Dryopteris lancipinnula Ching, *Sporae pterid. sin.*: 326 (1976), nom. nud. (Art. 32.1). Specimen: *H.-C. Wang* 1371, September 1941 (PE!).

Fronds becoming very large (up to *c.* 130 cm long), arising in a crown from the upright apex of a very thick, creeping rhizome. Stipe long, up to *c.* ½ the length of the lamina, thick, pale green, the base ± densely clothed with large, pale or pale brown, thin, matt, ovate scales which become slightly smaller and soon become very scattered further up the stipe and on the lower rachis, rachis often very slightly bent into zig-zags between the points of insertion of the upper pinnae. Lamina becoming three times pinnate below in larger plants, triangular-lanceolate (up to *c.* 60 cm wide), not tapered below, bearing up to *c.* 20 pairs of distant, or nearly contiguous pinnae; pinnae ± narrowly triangular-lanceolate, somewhat thickly herbaceous, but not coriaceous, pale green above, with the veins impressed into the surface, ± glabrous, bearing up to *c.* 17 pairs of large pinnules; pinnules long, narrowly triangular-lanceolate, stalked, except near the tips of the pinnae, ranging from almost unlobed in the upper parts of the lamina or throughout in small plants, to deeply pinnatifid, the lower pinnules of the lowest pinnae becoming pinnate in large, well-developed plants, pinnule-apices acutely pointed, bearing somewhat wide-based, acute teeth, pinnules on the basiscopic side of the lowest few pairs of pinnae usually becoming developed and longer than those on the acroscopic side; pinnulets or pinnule-lobes ± rectangular, with somewhat straight, or only slightly curved sides, and rounded, or rounded-truncate apices, bearing a few insignificant, acute teeth. Sori large, slightly crowded, in two rows, one on each side of the centre of the pinnule, slightly nearer the centre than the margins, the larger lobes or pinnulets in the lower pinnules themselves bearing two short rows of sori, indusiate; indusia slightly curved down at the edges, somewhat thick, becoming somewhat red-brown, lifting and shrivelling considerably, but mostly persistent. Spores regular.

Cytology: Diploid (W. Himalaya: Gibby (1985)). See also discussion below.

Ecology: A species of the upper-level forest zone, growing on the ground, usually beside streams at the edge of the forest, from *c.* 2400–3100 m alt.

Range: India (eastern parts of the W. Himalaya; E. Himalaya in Sikkim); Nepal; China (Yunnan). A somewhat uncommon Sino-Himalayan species of the widespread sort.

Range in the Indian subcontinent: **35** Jalaury Pass, [Kulu], *Mr Edgeworth* 161 (K!); **37** [Above] Simla, *Col. Bates* 8 bis (K!); **42** Garhwal, Rembara, 2800 m, 13 August 1968, *M. A. Rau* (BSD 38704!, PUN!), and stream, 2 km above Jangal Chatti, *c.* 12 km up path to Kedarnath mountain, north of Sonprayag, Mandakini valley, north of Rudraprayag, 2450 m, 15 September 1977, *C. R. Fraser-Jenkins* 7206–7209 (BM!), 7223 (BSD!), 7222 (FR!), 7212, 7220, 7224 (PE!), 7206 (Herb. T. Reichstein, Basel!) and 26 September 1978, *C. R. Fraser-Jenkins* 8394, 8404, 8408 (BM!), 8391, 8393, 8396–8403, 8405–8407 (H!), 8395, 8398 (PAN!), and Gaurikund to Kedarnath, 1982, *S. P. Khullar* 5218 (PAN!); **45** Khati to Dwali Road, Pindari, 2550 m, October 1965, *K. K. Dhir* 3193 (PAN 6463!) (Dhir, 1980); **51** Between Gargiankot and Munigaon, 10,000 ft (3040 m), 3 September 1952, *O. Polunin, W. R. Sykes & L. H. J. Williams* 3133 (BM!, E!); **59** Langtang, north of Kathmandu valley, 9550 ft (2905 m), October 1969, *R. L. Fleming* 1983 (K!, MICH!); **65** Lachen, 8000 ft (2440 m), 7 July 1909, *W. W. Smith & C. H. Cave* 2845 (CAL!), and [E. Himalaya] BSI no. E.2499 (CAL!), and Lachung, 9500 ft (2890 m), 8 August 1892, *G. A. Gammie* (CAL!, E!), and Sikkim, *J. D. Hooker* (BM!).

Notes: Only 18 collections of this species are known, including three from Yunnan, China, from where it is reported for the first time here. These three records are as follows: Tali, September 1941, *Wang, H.-C.* 1371 (PE!); Er Yueh Hsien, Fung Shan, Lung Tan Wan, *R. C. Ching* 23225

Fig. 47 *Dryopteris subimpressa*. India, Uttar Pradesh, Chamoli, below Kedarnath, Jangal Chatti, 15 September 1977, *C. R. Fraser-Jenkins* 7222 (FR). Scale line = 1 cm.

(PE!); Likiang, Yu Lung Shan, 2700 m, *Chu, W.-M.* 824 (YUKU!, Herb. Szechuan Forest Institute, Chengdu!).

Dryopteris subimpressa is a clearly distinct and recognisable species but has not usually been separated from other members of the *D. marginata* group. Some confusion surrounds its publication, so that reports of its cytology and distribution need reinvestigation and are not all accepted here, pending further study. Gibby (1985) has confirmed that a plant collected by the present author from the W. Himalaya is diploid, but, in addition to reporting a diploid sexual plant, Mehra & Loyal (1965) and Loyal (1969) also report a tetraploid sexual plant from N. Sikkim, which appears doubtful, though it cannot be excluded. The Sikkim plant was named *D. submarginata* by Loyal, following P. N. Mehra's advice as to its morphological similarities, though the original intention had been to use the name *D. subodontoloma* Loyal, as suggested by Ching to whom a specimen had been sent for comments. Unfortunately the name *D. submarginata* Loyal is a later homonym and cannot be used for the present species.

The type material of *D. submarginata* is identical in every respect to that of *D. subimpressa* Loyal, except that it was gathered from a large, mature plant, whereas the type material of *D. subimpressa* was taken from a smaller, immature, but fertile plant. Careful comparison by the present author reveals that exactly matching growth forms and intermediates can be found in a population of this single species from the W. Himalaya (*C. R. Fraser-Jenkins* 7206–7224, 8391–8408).

Loyal (1969) reports a difference in spore size between *D. submarginata* and *D. subimpressa*. However, measurements by the present author of spores from only the ripe sori among Loyal's material show a very much smaller, and insignificant, difference than that reported by Loyal (Table 1), the difference in spore-length at the lower end of the scale being only 2 μm, with the reported tetraploid plant being the smaller, and no difference being measured at the more important top end of the scale. In view of this significant new information and the exactly similar morphology of Loyal's two reported species, the two are united here. It is considered necessary to reinvestigate the cytology of the Sikkim and other populations before it can be fully accepted that there are two levels of ploidy within the species.

Table 1 Spore size in *Dryopteris subimpressa* and *D. submarginata*. Measurements are of the exospore.

	D. subimpressa Isotype (PAN 4350)	*D. submarginata* Isotype (PAN 2527)	*D. submarginata* *Fraser-Jenkins* 8394
Loyal (1969)	41·40 × 37·95– 49·33 × 41·74 μm	41·40 × 34·50– 59·34 × 45·80 μm	—
Fraser-Jenkins	39·3 × 27·2– 42·3 × 31·7 μm Mean = 39·7 × 29·7 μm	37·7 × 27·2– 42·3 × 33·2 μm Mean = 40·4 × 30·5 μm	37·7 × 27·2– 42·3 × 30·2 μm Mean = 40·2 × 28·7 μm

Some doubt must also surround the origin of the type specimens of *D. subimpressa*, though it is clear to what species they, and therefore the name, belong. Very careful and lengthy search by the present author of the exact type locality near Darjeeling as stated (and as mapped out and discussed with the author by Loyal, pers. comm. 1979), in two different years (1979 and 1980), failed to reveal any trace of the species, though the locality has not been interfered with or damaged since Loyal's visit. Instead, there are several plants present of another diploid sexual species, *D. marginata*, which has generally been confused by Indian and British authors with *D. caroli-hopei* and is therefore a little-known, but noticeably distinct, species itself. Furthermore, search by the author in the general area and in all the relevant herbaria has also failed to reveal any specimens of *D. subimpressa* from the Darjeeling region (which has been very well-collected indeed over a long space of time from the last century to the present day). All the other known localities of the species are close to the main ranges of the Himalaya, rather than in the lower, outer ranges such as in the vicinity of Darjeeling. It seems likely that there must have been some confusion of specimens and localities and that the types of *D. subimpressa* probably originated in north Sikkim, along with the specimens of *D. submarginata*. A possible hint of confusion is

contained in Mehra & Loyal's paper (1965), where they mention an entire population of individually occurring (i.e. spaced-out) plants, exactly similar to the situation with *D. marginata* at the stated type locality, whereas the label on one of the isotype specimens of *D. subimpressa* states, 'only one plant was found' and the protologue (Loyal, 1969) states, 'Collected one [misprint for once, Loyal, pers. comm. 1979] in the forest clearings', the presence of only a single plant being confirmed by Loyal (pers. comm. 1979). This suggests that the collection and diploid count from Darjeeling might have applied to *D. marginata* and that the specimens might have been confused at some time between 1957 (the date of collecting) and 1965 (the date that *D. subimpressa* was first detailed in print). In view of the date of Ching's determination (1957) written on the sheet of *D. submarginata* in Peking, which must be part of the original collection, the date cited for *D. submarginata* must also be in doubt. Furthermore, for a period of some ten years the specimens lay unmounted in piles of folders at Chandigarh, during which time the specimens or labelling could have been confused. It appears too that the type material of *D. subimpressa* is labelled at present with two different years of collection, though it was all collected at the one time according to Loyal (pers. comm. 1979). The record of *D. subimpressa* from Darjeeling is therefore not accepted here, pending further investigation.

43. Dryopteris approximata Sledge **Fig. 48**

in *Bull. Br. Mus.nat. Hist.* (Bot.) **5** (1): 11 (1973). Type: Sri Lanka, Central Province, 1861, *Thwaites* C.P. 1375 (PDA – holotype; BM!, CGE!, E!, K!, PDA – isotypes). Other specimens labelled in the same way as the isotypes, but not cited in the protologue, are in B! and P!.

Misapplied names: Lastrea elongata sensu Beddome (1864); *Dryopteris marginata* and *D. ramosa* sensu Bir & Vasudeva (1971).

Fronds large (up to *c.* 130 cm long), arising in a crown from a thick, ± prostrate rhizome with an ascendent apex. Stipe long, up to *c.* ⅔ the length of the lamina, thick, the base densely clothed with large, pale or pale brown, thin, matt, ovate-lanceolate and narrowly lanceolate scales, which become scattered and very narrow further up the stipe and very small and scattered on the rachis, being mostly confined to the points of insertion of the pinna-costae. Lamina twice pinnate, or just becoming three times pinnate below, widely triangular-lanceolate, becoming almost deltate (up to *c.* 55 cm wide), not tapered below, bearing up to *c.* 22 pairs of ± contiguous or overlapping pinnae; pinnae ± narrowly triangular-lanceolate, or somewhat linear-lanceolate above, with slightly caudate apices, herbaceous, often slightly glossy and pale- to mid-green above, usually with the veins slightly impressed on the top surface, ± glabrous apart from a few very scattered, very small and narrow, hair-like, pale scales on the costae below, bearing many (up to *c.* 25 pairs) ± large pinnules; pinnules long, narrowly triangular-lanceolate, or somewhat lanceolate, markedly closely sessile to the pinna-costa even though attached by a very short stalk, the lowest pair of pinnules on each pinna very close to, and usually overlapping, the rachis, pinnules ranging from shallowly lobed in the mid and upper parts of the lamina to deeply pinnatifid below, just becoming pinnatisect in the lowest pinnules of large, well-developed plants; pinna-lobes somewhat crowded, ± rounded, or oval in shape, without teeth, or bearing a few insignificant, small, acute teeth, pinnule-apices obtusely pointed, bearing a few insignificant, small, acute teeth, or almost without teeth, pinnules on the basiscopic side of the lowest pair of pinnae usually becoming developed and longer than those on the acroscopic side. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule, midway between the centre and margins of the pinnule, the larger lobes near the base of the lower pinnules themselves bearing two short rows of sori, indusiate; indusia slightly curved down at the edges, thin, becoming pale brown, lifting and shrivelling considerably and mostly dropping off later. Spores regular.

Cytology: Unknown.

Ecology: A species of mid-level forests and roadside banks, growing on the ground, from *c.* 1600–2000 m alt.

Fig. 48 *Dryopteris approximata.* India, Tamil Nadu, Palni Hills, north of Kodaikanal, 19 December 1978, *C. R. Fraser-Jenkins* 9162 (BM). Scale line = 1 cm.

Range: India (south); Sri Lanka. An endemic species probably to be considered of Sino-Himalayan affinity.

Range in the Indian subcontinent: **93** Nilgiris, Lamb's Rock, Shola, 6000 ft (1830 m), September 1883, *J. S. Gamble* 12407 (K!); **94** Roadside stream, 8 miles north of Munnar on Udamalpet road, Anamalai Hills, 1850 m, 23 December 1978, *C. R. Fraser-Jenkins* 9255 (BM!); **95** Dense woods in valley, 4½ miles north-east of Kodaikanal on Perumalmalai road, north side of Palni Hills, 1600 m, 21 December 1978, *C. R. Fraser-Jenkins* 9234, 9235 (BM!), 9234–9238, 9241, 9242 (H!); **100** Madulsenia, *G. Wall* 44/73 (K!).

Notes: This species was confused with others until Sledge (1973) noticed that it was distinct. Its most distinctive features are the markedly sessile pinnules, the lowest ones on each pinna overlapping the rachis, with more oval, less toothed and less deeply cut lobes and somewhat more caudate pinnule-apices than in other members of the section. The small spore-size suggests that it may well be a diploid sexual species.

44. **Dryopteris marginata** (C. B. Clarke) Christ **Fig. 49**

in *Philipp. J. Sci.* C (Bot.) **2**: 212 (1907). – *Aspidium marginatum* Wallich, *Num. List*: no. 391 (1828), pro parte max., nom. nud. (Art. 32.1). – *Nephrodium filix-mas* var. *marginatum* C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 521, pl. 71 (1880). – *Aspidium filix-mas* var. *marginatum* (C. B. Clarke) Christ in *Bull. Herb. Boissier* **6**: 967 (1898). – *Nephrodium marginatum* (C. B. Clarke) C. Hope in *J. Bombay nat. Hist. Soc.* **14**: 740, excl. pl. 33 (1903). – *Aspidium marginatum* (C. B. Clarke) Christ in *Mém. Soc. bot. Fr.* **1** (1): 39 (1905), nom. illeg. (Art. 64.1), non Schk. (1809). Type: Nepal, 1821, *Wallich* 391 (K-W! – lectotype, selected here; K! – isolectotype).

Dryopteris blinii A. Léveillé, *Fl. Kouy-Tchéou*: 490 (1915). Type: China, Kouy Tschéou, Pin-Fa, November 1907, *J. Cavalerie* 2886 (P! – lectotype, selected here; E! – isolectotypes).

Dryopteris grandissima Tag. in *Acta phytotax. geobot. Kyoto* **3**: 89 (1934). Type: Taiwan, Mt Daibu, prov. Takao, 9–11 May 1933, *J. Ohwi* 1873 (KYO! – holotype).

Dryopteris metcalfii Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 463 (1938), nom. illeg. (Art. 64.1), non *metcalfei* (Baker) C. Chr. (1905). Type: China, Kwangsi, Kweilin District, Hsi-Chang village and vicinity, Ch'i-Fen-Shan, 1–11 October 1937, *W. T. Tsang* 28463, Fifth Lingnan Kwangsi Expedition (PE! – lectotype, selected here; IBSC!, SYS! – isolectotypes).

Dryopteris leveillei Nakai in *Bull. natn. Sci. Mus. Tokyo* **31**: 17 (1952), nom. illeg. (Art. 63.1), non Christ (1909). Type: as for *Dryopteris marginata*.

Fronds very large (up to *c.* 150 cm long), arising in a crown-like arrangement from a thick, prostrate thizome with an ascendent apex. Stipe long, *c.* ⅔ as long to the same length as the lamina, thick, ± glossy, the base densely clothed with thin scales (thicker than in *D. caroli-hopei*), which stand out and are somewhat glossy, ovate-lanceolate, and pale to pale brown, and which rapidly become very scattered, smaller and narrower further up the stipe, and ± absent from the upper stipe and rachis. Lamina three times pinnate, widely triangular-lanceolate (up to *c.* 70 cm wide), not tapered below, bearing up to *c.* 20 pairs of contiguous or overlapping pinnae; pinnae triangular-lanceolate, herbaceous, ± thin, pale green above, with a smooth or slightly glossy upper surface, ± glabrous, bearing many (up to *c.* 21 pairs) large pinnules; pinnules long, ± narrowly triangular-lanceolate, stalked, pinnatisect, except near the tips of the pinnae, where they are deeply pinnatifid, pinnule-apices obtusely or somewhat acutely pointed, bearing a few insignificant, acute teeth, pinnules on the basiscopic sides of the pinnae in the lower half of the frond developed and longer than those on the acroscopic side, especially in the lower pinnae, where they are markedly longer; pinnulets or pinna-lobes ± rectangular, usually with ± parallel, straight sides and wide, rounded-truncate apices, bearing a few insignificant, acute teeth, the lower pinnulets in large, well-developed fronds sometimes becoming somewhat more ovate with a rounded apex and the sides bearing rounded lobes. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule or pinnulet, midway between the centre and the margins, indusiate; indusia ± flat, thin, shrivelling markedly, lifting and mostly dropping off on ripening. Spores regular.

Cytology: Diploid sexual (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal*, 20 August 1957 (PAN 1319!, 1415!). Gibby (1985)).

Ecology: A species of the lower mid-level and mid-level forests, growing on the ground in damp forest or occasionally on overgrown damp banks, from *c.* 1600–2500 m alt.

Range: E. Nepal; India (E. Himalaya in Sikkim; Assam); Bhutan; ? N. Burma; China (Yunnan, Kweichow, Kwangsi, Fukien); Taiwan; Thailand; N. Vietnam. A Sino-Himalayan species of the east Himalayan sort, with an extension of its range further east.

Range in the Indian subcontinent: **58** 'Napalia', 1821, *Wallich* 391 (B!, BM!, K!, P!, etc.), with *D. caroli-hopei*; **62** Arun valley, Maghang Khola, east of Num, 8000 ft (2440 m), 6 September 1956, *J. D. A. Stainton* 1592 (BM!); **64** Forest, Manebhanjang to Sukia Pokhri, south-west of Darjeeling, *c.* 2200 m, 16 November 1978, *C. R. Fraser-Jenkins* 8548 (BM!), 8550 (FR!); **65** Sikkim, 1868, *W. S. Atkinson* (*Clarke* 8279A) (K!); **70** Gale Chu valley, 5000 ft (1520 m), 27 April 1937, *F. Ludlow & G. Sherriff* 2941 (BM!); **78** Tirap Frontier District, Rahoto Vokanoska, 26 August 1958, *G. Panigrahi* 16808 (ASSAM!); **79** Borsilla [= Barsala, nr Jorhat], 1874, '*A soldier*' (BM!); **80** Ukhrul, Hongra Hill, 27 February 1978, *R. D. Dixit* 59098 (CAL!); **83** Stream gulley, below Peak Lodge, 10 km above Shillong on road to the Peak, 1800 m, 24 November 1978, *C. R. Fraser-Jenkins* 8795, 8796 (H!).

Notes: This somewhat little-known species has been widely over-reported in the Indian subcontinent in error for *Dryopteris caroli-hopei*, with which it is much confused. *D. caroli-hopei* occurs commonly in both the west and east Himalaya, but *D. marginata* is confined to the wetter parts of the east Himalaya and Assam, and can be readily separated as the former has somewhat darker, noticeably thinner, irregular, adpressed stipe-scales, which appear almost irregularly broken up, and a markedly matt, almost grey-green lamina, with impressed veins on the upper surface, and less rectangular, more toothed segments.

It is clear from his description and illustration that Clarke (1880) was referring to the present

Fig. 49 *Dryopteris marginata*. India, West Bengal, Darjeeling, Manebhanjang to Sukia Pokhri, 16 November 1978, *C. R. Fraser-Jenkins* 8550 (FR). Scale line = 1 cm.

species and not to *D. caroli-hopei*, even though Wallich's gathering was partly mixed. Therefore a lectotype is chosen as mentioned above, Christ's combination being based on Clarke's name.

D. marginata was reported from the Philippines by Christ (1907), in error for *Dryoathyrium boryanum* (Willd.) Ching (Price, pers. comm. 1981). It is certain that it does not occur in Korea, as reported by Nakai (1911, 1952), perhaps in error for *D. goeringiana* (Kunze) Koidz. A specimen from Thailand, reported by Tagawa & Iwatsuki (1968) as *D. porosa* Ching, belongs to the present species.

45. Dryopteris caroli-hopei Fraser-Jenkins, **sp. nov.** **Fig. 50**

Aspidium marginatum Wallich, *Num. List*: no. 391 (1828), pro parte min., nom. nud. (Art. 32.1), non Schk. (1809). Specimens in BM!, K!, K-W!

Aspidium dilatatum var. *patuloides* Christ in *Mém. Soc. bot. Fr.* **1** (1): 41 (1905). Type: China, Yunnan, lieux frais et ombragés a Mo-Che-Tchin, au dessus de Ta Pin Tze, près de Tali, 1500 m, 1883–5, *J. M. Delavay* 1204 (P! – lectotype, selected here).

Dryopteris pseudomarginata Ching, *Sporae pterid. sin.*: 327 (1976), nom. nud. (Art. 32.1). Specimens in PE!

Misapplied names: Lastrea filix-mas var. *elongata* sensu Beddome (1876, 1883), pro parte (with synonym, *Aspidium canariense* sensu Beddome); *Nephrodium marginatum* sensu C. Hope (1903), see pl. 33; *Dryopteris marginata* auct. Indian., etc. (west Himalaya).

Planta *D. marginatae* similis, sed paleis stipitis parvioribus impolitis adpressis irregulariter formatis, lamina impolita venulos parum fuscatos impressosque supra praebens, pinnulis segmentis ovalibus, apice acutis, dentibus acutis insignibus instructis, differt. Type: N. India, Uttar Pradesh, north of Dehra Dun, east side of Mussoorie, Landour, St Paul's church, below conifers, *c.* 2300 m, 22 October 1978, *C. R. Fraser-Jenkins* 8197 (BM! – holotype). Other specimens from the type locality are located as follows: 8201 (BM!), 8203 (FR!), 8204 (G!), 8198–8208 (H!).

Fronds large (up to *c.* 120 cm long), two or three arising from the apex of a thick, prostrate, partly underground rhizome. Stipe long, *c.* ⅔ the length to the same length as the lamina, thick, matt, the base somewhat densely clothed with irregular, somewhat adpressed, thin, matt, ovate-lanceolate, pale brown, or slightly russet-brown scales, mixed with very small, closely adpressed, lanceolate ones, scales rapidly becoming very scattered, very narrow and almost lanate further up the stipe, ± absent from the upper stipe and rachis. Lamina three times pinnate, widely triangular-lanceolate (up to *c.* 60 cm wide), not tapered below, bearing up to *c.* 20 pairs of contiguous pinnae; pinnae triangular-lanceolate, herbaceous, pale greyish-green above with a markedly matt upper surface in which the venules are often slightly darkened and very slightly impressed, ± glabrous except for a few very scattered, small, very narrow, hair-like, pale scales on the costae below, bearing up to *c.* 22 pairs of large pinnules; pinnules long, ± narrowly triangular-lanceolate, stalked, pinnatisect except near the tips of the pinnae, where they are ± deeply pinnatifid, pinnule-apices obtusely or somewhat acutely pointed, bearing somewhat prominent, acute teeth, pinnules on the basiscopic side of the pinnae in the lower half of the frond developed and longer than those on the acroscopic side, especially in the lowest pinnae where they are markedly longer; pinnulets or pinnule-lobes ovate-lanceolate, with rounded or somewhat obliquely pointed apices and bearing somewhat prominent, acute teeth around them, often turned up slightly out of the plane of the segment, pinnulets in the lower pinnules of large, well-developed plants shallowly lobed around the edges. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule or pinnulet, midway between the centre and margins, indusiate; indusia ± flat, thin, shrivelling markedly, lifting at the edges and dropping off on ripening. Spores regular.

Cytology: Diploid sexual (W. Himalaya: Verma & Loyal (1960), sub *D. marginata*. Loyal in Mehra (1961), sub *D. marginata* and *D. ramosa*. Mehra & Loyal (1965), sub *D. ramosa*, no voucher specimens made or cited. Mehra & Khullar (1980), sub *D. marginata*, voucher specimens, *S. P. Khullar* 143, July 1967 (PAN 6004!, 6005!). Gibby (1985)).

Ecology: A common species of the lower mid-level and mid-level forests, growing on the ground, often on roadside banks or in light forest, from *c.* 1300–2200 m alt.

Range: India (W. Himalaya; E. Himalaya in N. Assam; Assam); Nepal; Bhutan; SE. Tibet; China (Yunnan); ? N. Burma. A Sino-Himalayan species of the widespread sort, not extending to the far west Himalaya. Absent from the wetter parts of the east Himalaya in Sikkim, etc., or confined to the main-range areas, and thus tending slightly towards a bicentric west Himalayan species.

Range in the Indian subcontinent: **28** Vaishodevi, Jammu, *S. P. Khullar* (PAN), teste S. P. Khullar (pers. comm. 1982); **32** Chamba Hills, 1887, *J. Marten* (DD!); **33** Stream *c.* 25 km south-west of Chamba on Dalhousie road, south side of Ravi valley, *c.* 1300 m, 8 September 1978, *C. R. Fraser-Jenkins* 7753 (BM!); **34** Near Dihlu, 4500 ft (1370 m), 6 August 1887, *E. W. Trotter* (RAW!); **37** Simla, The Glen, 5000 ft (1520 m), 23 September 1888, *E. W. Trotter* (RAW!); **40** Mussoorie, 5–7000 ft (1520–2130 m), 12 July–30 August 1934, *R. R. Stewart & R. L. Fleming* (MICH!); **41** Kedarkanta, *J. F. Royle* 199/55 (LIV!); **42** 1 km

Fig. 50 *Dryopteris caroli-hopei.* India, Himachal Pradesh, Simla, 9 September 1977, *C. R. Fraser-Jenkins* 7056 (BM). Scale line = 1 cm.

below Narainkoti, 44 km up Mandakini valley from Rudraprayag, north of Okimath, north-east of Rishikesh, 1350 m, 14 September 1977, *C. R. Fraser-Jenkins* 7156, 7157 (BM!); **43** 1 km north-east of Joshimath on Badrinath road, north-east of Rishikesh, Alaknanda valley, *c.* 1700 m, 17 September 1977, *C. R. Fraser-Jenkins* 7243 (BM!); **44** Pauri, *S. Basu* (CAL!); **45** Pindhar gorge, Khati, 7000 ft (2130 m), 9 September 1891, *E. W. Trotter* 808 (RAW!); **47** Bhowali, on rocks, 6000 ft (1830 m), November 1979, *S. P. Khullar* 38 (PAN!); **48** Dhunaghat, 6000 ft (1830 m), 4 October 1891, *E. W. Trotter* (RAW!); **51** Samela, 7000 ft (2130 m), 15 October 1952, *O. Polunin, W. R. Sykes & L. H. J. Williams* 5687 (BM!, E!); **53** Gaja Lekh, Baglung, 3 December 1973, *D. P. Joshi & M. M. Amatya* 0333 (KATH!); **57** Sim Chotula (900 m) to Ramche (1800 m) to Grau (1900 m), 20 August 1972, *H. Kanai, H. Hara & H. Ohba* 725888 (KATH!); **58** Nagakot, 6500 ft (1980 m), 29 August 1966, *Mrs Prabha & Miss Ramola* 6338 (KATH!); **59** Langtang, Rasuwa, Ghoda Tabela to Thulosyapru, 7 October 1977, *V. L. Gurung & party 77/739* (KATH!); **60** Gongar to Chhetchet, Dolkha District, 14 July 1977, *K. R. Rajbhandari & B. Roy* 1361 (KATH!); **62** Bir Gaon (1600 m) to Saju Khola to Dingla, 1 July 1972, *H. Kanai et al.* 725437 (BM!, KATH!); **67** Bhutan?, *W. Griffith* 761, 812 (B!); **68** Ritang (2400 m) to Ratsoo (1850 m), 23 April 1967, *H. Kanai et al.* 9003 (TI!); **74** Below Sela Pass, West Tawang, *P. Chandra* 80401, 80422 (LWG!); **79** Kohima, Kulni Picket, 4200 ft (1280 m), 30 July 1942, *N. L. Bor* 16270 (CAL!, DD!); **80** Manipur (CAL!); **83** ½ km west of Non, near Laitjem, 11 km east of Mawphlang on Shillong road, west of Shillong, 1750 m, 26 November 1978, *C. R. Fraser-Jenkins* 8865, 8866 (BM!); **84** Garo Hills, 9 January 1963, *S. C. Choudhury* 29648 (CAL!).

Notes: This species has been widely confused with the east Himalayan and Chinese (etc.) species, *Dryopteris marginata*, from which it has not been separated until now, so that the many records of *D. marginata* from the west Himalaya actually refer to *D. caroli-hopei*. The two can be distinguished as *D. marginata* has thicker, paler and more glossy stipe-scales which stand out more from the smoother stipe, and a smooth, slightly glossy lamina with more rectangular segments and fewer, smaller teeth.

D. caroli-hopei has also been confused to a lesser extent with *D. ramosa* and *D. stewartii*, to which records from the far west Himalaya (Kashmir and westwards), except that of Khullar cited above, refer (e.g. Hope (1903) and Stewart (1945), who correctly doubted Hope's records).

Wallich's original collections, labelled *Aspidium marginatum* in various herbaria, contain a mixture of *D. marginata* and *D. caroli-hopei* (and species from other genera), though they are predominantly *D. marginata*. Clarke (1880) first took up the epithet *marginatum* and applied it to the east Himalayan species here referred to as *D. marginata*, but although Hope (1903) made a new combination based on Clarke's name, his concept was mainly of the present species, which is therefore named after Hope, in whose book it is illustrated remarkably accurately. Hope's Christian name, Charles, is included in the name in order to avoid confusion or possible homonymy with *D. hopeana* (Baker) Kuntze (not a *Dryopteris* species).

The syntype specimens of *Aspidium dilatatum* var. *patuloides* consist mostly of *D. caroli-hopei*, but one (*Ducloux* 674 (P!)) is *D. pteridiiformis*. This, however, is certainly a mere misidentification on Christ's part, and the lectotype chosen here fits Christ's description of a taxon with a wide and thin lamina far better. Spore dispersal in *D. caroli-hopei* has been studied by Loyal (1981, sub *D. marginata*; 1985).

46. Dryopteris ramosa (C. Hope) C. Chr. **Fig. 51**

Index filic.: 287 (1905). – *Nephrodium ramosum* C. Hope in *J. Bot., Lond.* 34: 126 (1896). Type: Pakistan, Guger, 10,000 ft, 18 May 1895, *Surg.-Lt. Harriss*, Chitral Relief Expedition 1895, *Duthie* 16855 (K! – lectotype, selected here).

Fronds large or very large (up to *c.* 100 cm long), two or three fronds arising from the apex of a markedly long, prostrate, underground rhizome, densely surrounded with leaf-bases. Stipe long, *c.* ½ the length of the lamina, thick, the very base densely clothed with long, narrowly lanceolate, thin scales which become lanceolate to ovate-lanceolate on the widest part of the stipe-base, remaining large and dense, but becoming smaller and less dense further up the stipe so that the upper stipe and lower rachis bear scattered, small, lanceolate scales, scales pale- to mid-brown at the stipe-base, sometimes with ± small, dark, blackish-brown patches near the bases (mainly in large plants), the scales on the upper stipe varying from pale- to sometimes nearly all dark brown in large plants. Lamina three times pinnate, widely triangular-lanceolate,

or ± deltate (up to *c.* 50 cm wide), not tapered below, bearing up to *c.* 25 pairs of contiguous pinnae, which often become slightly overlapping in large, foliose plants; pinnae triangular-lanceolate, thinly herbaceous, pale green above, with matt upper surface, ± glabrous, except for a few scattered, small, very narrow, hair-like, pale scales on the costae below, bearing up to *c.* 25 pairs of large pinnules; pinnules long, narrowly triangular-lanceolate, stalked, pinnatisect, but becoming deeply pinnatifid in the upper part of the lamina, pinnule apices long and acutely pointed, bearing prominent, fine, acute teeth, pinnules on the basiscopic side of the pinnae in the lower half of the frond becoming well-developed and longer than those on the acroscopic side, very markedly so in the lowest pair of pinnae; pinnulets or pinnule-lobes small, ovate-lanceolate, with ± acutely pointed apices, bearing prominent, fine, acute teeth around them, the pinnulets in the lowest pinnules of lower pinnae themselves bearing lobes at the sides. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule or pinnulet, midway between the centre and margins, indusiate; indusia small, flat, very thin, shrivelling markedly and soon dropping off when the spores ripen (earlier in the season (about July) than in *D. caroli-hopei*). Spores regular.

Cytology: Diploid sexual (W. Himalaya: Mehra & Khullar (1980), voucher specimens, *S. P. Khullar* 10, 12, 15, July 1965 (PAN 5367!, 5369!, 5372!) and *S. P. Khullar* 79, June 1966 (PAN 5436!, 5437!). The reports by Loyal in Mehra (1961) and Mehra & Loyal (1965) refer to *D. caroli-hopei*).

Ecology: A species of the mid- and upper-level forest zones, growing on the ground in rich forest, from *c.* 2000–4000 m alt.

Range: NE. Afghanistan; Pakistan (Himalaya west and east of the Indus); India (W. Himalaya); NW. Nepal (rare). A Sino-Himalayan species of the west Himalayan sort.

Range in the Indian subcontinent: **2** Prov. Kunar, Bashgaltal, Bargematal to Kamdesh, 2000 m, *S.-W. Breckle* A 3248 (Herb. Breckle, Bonn!); **10** Kurram valley, Shend Toi, 9–10,000 ft (2740–3040 m), 8 July 1879, *J. E. T. Aitchison* 764, and 10 July 1879, *J. E. T. Aitchison* 788 (B!, K!); **12** Dir, Gujar, 7000 ft (2130 m), 29 June 1953, *M. A. Siddiqui* 27138 (RAW!); **13** Ziarat, 7–8000 ft (2130–2440 m), 21 May 1895, *S. A. Harriss* (*Duthie* 16856) (DD!, K!), and Mirga, 8500 ft (2590 m), 13 September 1895, *Brig.-General W. Gatacre* 17643 (BM!, DD!, E!); **14** Swat, Mt Ilam, 8–9000 ft (2440–2740 m), 12 August 1952, *R. R. Stewart* 24360 (RAW!); **15** Gilgit, 8000 ft (2440 m), June 1880, *Tanner* 307 (DD!), and Gurai, 8800 ft (2680 m), 24 August 1886, *Dr Giles* 721 (DD!); **19** Burzil, Chowki, 11,000 ft (3340 m), 28 August 1939, *R. R. & I. D. Stewart* 19133 (CAL!, RAW!); **20** About 3 km north of Changla Gali, south of Ayubia turn-off from Abbottabad road, Murree Hills, 2400 m, 6 August 1978, *C. R. Fraser-Jenkins* 7373, 7379 (BM!), 7373, 7379–7383 (H!); **21** Near Kel, Kishenganga valley, 6500 ft (1980 m), 2 October 1940, *F. Ludlow & G. Sherriff* 8247 (BM!), and Sharda, Kishenganga valley and road to Nanga Parbat, 20–21 July 1939, *R. R. & I. D. Stewart* 17731 (RAW!); **23** Near Hajipur, Poonch, *c.* 7000 ft (2130 m), 3 July 1952, *R. R. Stewart & E. Nasir* 24070 (RAW!); **24** Gulmarg, September 1955, *T. C. Mittal* 75 (PAN 1135!, 1136!, 1139!, 1141!, 3093–3096!); **25** Lolab, Andrbug, 7000 ft (2130 m), September 1891, *R. W. Macleod* (RAW!); **26** Pahlgam, September 1955, *T. C. Mittal* 6 (PAN 1137!), and *T. C. Mittal* 77 (BM!); **27** Banihal Pass, 8000 ft (2440 m), July 1934, *R. R. Stewart* 14098B (PE!); **29** About 2 km west of Meenamarg, east side of Zojila Pass, Dras to Sonamarg, 3350 m, 17 August 1978, *C. R. Fraser-Jenkins* 7449 (BM!); **32** Chamba, 1898, *J. Marten* (K!); **33** Dharmkot, Dharmsala, *c.* 8000 ft (2440 m), 19 May 1917, *R. R. & I. D. Stewart* 1905 (PE!); **35** Parbati valley, Kulu District, 9000 ft (2740 m), 18 July 1952, *E. Schelpe* 3581 (BM!); **37** Matiana Hill, above Nagkanda, east of Simla, 21 September 1884, *H. F. Blanford* (P!); **38** Haran Ghati, Baspa valley, Simla Hill States, 13,500 ft (4090 m), 29 July 1939, *G. Sherriff* 7456 (BM!); **39** Bajamara, Jaunsar, 7500 ft (2290 m), June 1898, *J. S. Gamble* 27109 (K!, P!); **41** Phulul Dhar, Nila valley, Ganga valley, 12,000 ft (3640 m), 1 August 1906, *P. W. Mackinnon* (CAL!), and Tihri Garhwal, Rhudughera, 10–11,000 ft (3040–3340 m), 21 July 1883, *J. F. Duthie* 139 (K!); **53** Tuli Gad, below Lulo Khola, 12,500 ft (3790 m), 16 September 1952, *O. Polunin, W. R. Sykes & L. H. J. Williams* 3451 (BM!, E!).

Notes: Dryopteris ramosa was described a second time and illustrated by Hope (1903), who suggested that it was related to *D. blanfordii* (see under that species). On morphological grounds it is probable that it is part-ancestral to both *D. blanfordii* and *D. stewartii*. At the diploid level its nearest relationships appear to be with the rare endemic Japanese species, *D. shiroumensis* Kurata & Nakaike, and the widespread far-eastern species, *D. goeringiana*

Fig. 51 *Dryopteris ramosa.* India, Kashmir, Sonamarg to Ganderbal, Gund, 27 August 1977, *C. R. Fraser-Jenkins* 6550 (BM). Scale line = 1 cm.

(Kunze) Koidz. (synonyms: *D. laeta* (V. Komarov) C. Chr., *D. wladiwostokensis* B. Fedtsch., etc.) from N. China, far-eastern Siberia, Korea, and Japan.

From approximately the Kulu area eastwards this species retreats towards the main Himalayan ranges and becomes rare and scattered. It was reported from Mussoorie by Dhir & Sood

(1981) in error for *D. stewartii* (photograph seen). So far there is only one collection from Nepal, as cited above, from where it is reported for the first time, though it may be expected to occur elsewhere in far-western Nepal and in the easternmost part of the west Himalaya. *D. ramosa* replaces *D. caroli-hopei* in the far west Himalaya, in Kashmir, etc., though, in herbaria, there is often some confusion between the two. Small plants have also been confused with the European, N. and W. Asian, and N. American species, *D. carthusiana* (Villars) H. P. Fuchs (synonym: *D. spinulosa* (Roth) Kuntze), which is absent from the Himalaya, though reported in error by Beddome (1870, pl. 336; 1892) on the basis of a specimen (K!) originating from Europe but labelled as being from Kashmir.

Subgenus 2. Erythrovariae (H. Itô) Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 195 (1986).

Section 1. Erythrovariae

47. Dryopteris assamensis (C. Hope) C. Chr. & Ching **Fig. 52**

in *Bull. Dep. Biol. Coll. Sci. Sun Yatsen Univ.* **6**: 4 (1933). – *Nephrodium assamense* C. Hope in *J. Bot., Lond.* **28**: 326 (1890). – *Lastrea filix-mas* var. *assamensis* (C. Hope) Beddome, *Suppl. ferns Brit. Ind.*: 57 (1892). – *Dryopteris filix-mas* subsp. *assamensis* (C. Hope) C. Chr., *Index filic.*: 266 (1905). Type: India, Assam, Nambar, January 1888, *G. Mann* 10, Herb. Hope (P! – lectotype, selected here).

Dryopteris neoassamensis Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 480 (1938). Type: China, Kwangtung, Yang Shan and vicinity, Mong Ts'o, south of Linchow, July–September 1932, *T. M. Tsui* 435 (PE! – lectotype, selected here; K! – isolectotype).

Fronds medium-sized (up to *c.* 55 cm long). Stipe long, up to *c.* ½ the length of the lamina, somewhat thin, the base very dark brown and somewhat densely clothed with stiff, ± long, very narrowly linear-lanceolate, glossy, ± dark brown, or nearly blackish scales, which rapidly become very small, very scattered and mid-brown further up the stipe and on the rachis. Lamina becoming twice pinnate near the bases of the mid and lower pinnae, somewhat narrowly lanceolate (up to *c.* 15 cm wide), usually tapering somewhat to a slightly truncate base, bearing up to *c.* 20 pairs of separate pinnae; pinnae linear-lanceolate or ± linear, somewhat stiffly herbaceous, but not thick, mid- or somewhat dark green above, bearing scattered, small, very narrow, ± pale brown scales, sometimes weakly bullate at their bases, on the costae below, and bearing few (up to *c.* 12 pairs) ± small lobes or pinnules; pinnules or pinna-lobes ± short, longer than broad, rectangular, widely attached (adnate) to the pinna-costa and connected to each other by a narrow wing of tissue except at the bases of the pinnae, where they become fully separated into pinnules, those at the very bases of the pinnae becoming somewhat narrowly attached to the costae, ± parallel-sided, though the lower pinnules are often slightly narrower at their bases than at their apices, and mostly unlobed except for the lower ones in lower pinnae which are frequently somewhat auriculate at their basiscopic bases, and except in larger plants where they bear shallow, ± pointed lobes, pinnule margins bearing a few acute teeth, pinnule-apices markedly truncate, or occasionally slightly rounded-truncate, bearing somewhat irregular, ± long, acute teeth. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule, midway between the centre and the margins, or slightly nearer the margins, indusiate; indusia slightly curved over the sorus, somewhat thick, becoming mid-brown, shrivelling and lifting slightly, but mostly persistent. Spores irregular, with fully formed and abortive spores.

Cytology: Unknown. A report of a triploid apomict from Yakushima, S. Japan (Hirabayashi, 1970) refers to another species.

Ecology: A species of the lower-middle forest zone, growing on the ground, from *c.* 300–1600 m alt.

Range: India (E. Himalaya in the Sikkim region; Assam); China (Kwangtung, Kweichow); Hong Kong. Probably a south-east Asian element.

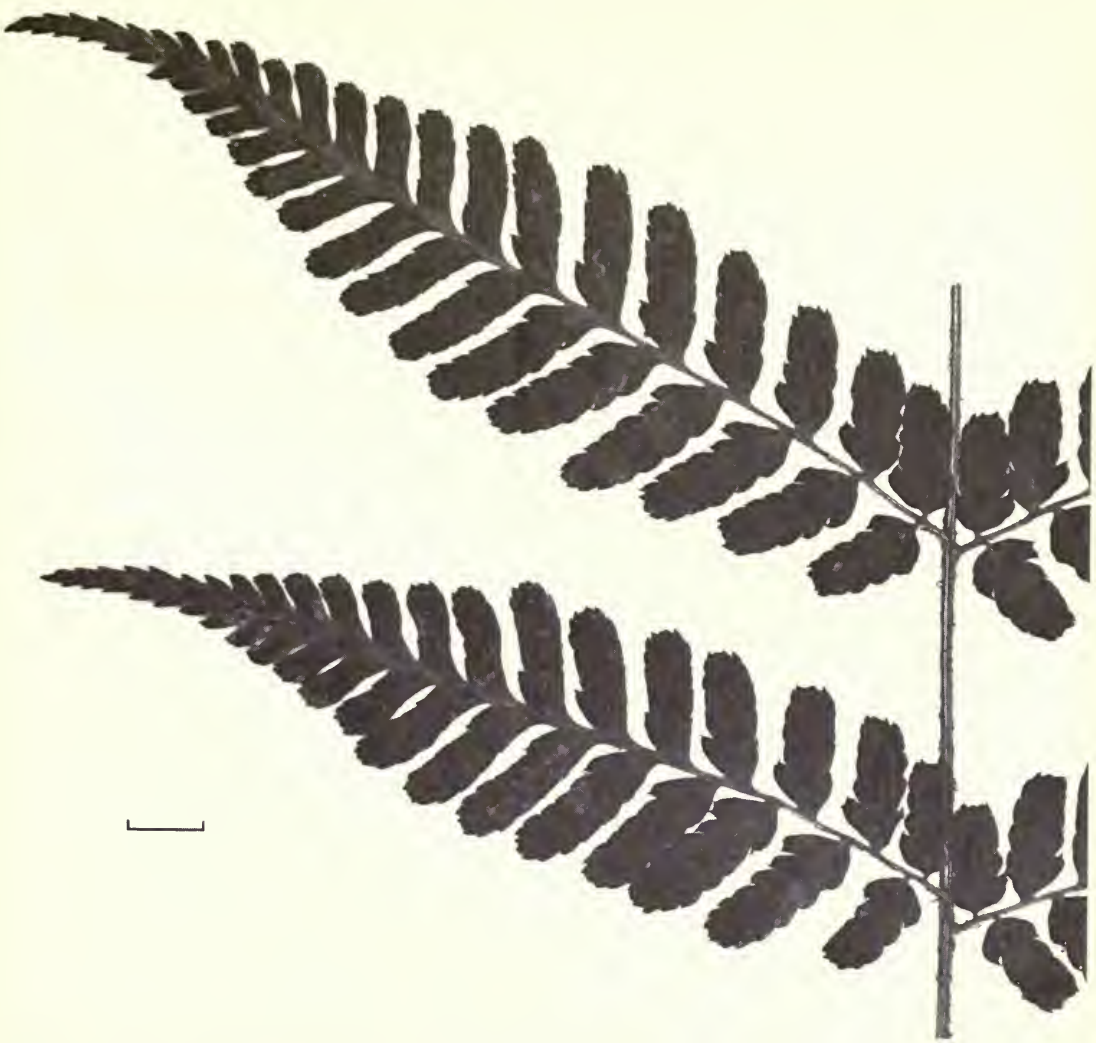

Fig. 52 *Dryopteris assamensis*. India, Assam, Borsilla, September–November 1870, '*A soldier*' (BM). Scale line = 1 cm.

Range in the Indian subcontinent: **64** Dulkajhar, 5000 ft (1520 m), 16 October 1884, *C. B. Clarke* 36790F (CAL!, DD!, K!); **78** Bor Bheel, Nakum Forest, Upper Dehing Forest, Lakhimpur, April 1887, *G. Mann* (M!); **79** Borsilla [= Barsala, nr Jorhat], 1874, '*A soldier*' (BM!), and Nambar Forest, February 1891 and November 1899, *G. Mann* (B!, BM!, DD!, E!, K!, MICH!, PE!, RAW!); **83** Khasya, *W. Griffith* (with *D. sparsa*) (K!); **84** Garo Hills, 1000 ft (300 m), December 1885 and November 1889, *G. Mann* (K!).

Notes: Dryopteris assamensis is unusual in having only very weakly bullate scales on the lower surface of the pinna-costae or upper rachis, and so has not previously been placed with other members of the subgenus *Erythrovariae*. However, though superficially slightly similar to some members of the section *Fibrillosae*, its stipe-scales, segment shape (narrower at the base) and lamina texture show it to be a member of the subgenus *Erythrovariae*, but which, in common with four other species, is usually more or less without bullate scales (see Fraser-Jenkins, 1986).

Some specimens from SE. China have been described as another species, *D. neoassamensis* Ching. However, the type of *D. neoassamensis* matches *D. assamensis* exactly, and though Ching states that it has slightly paler stipe-scales, their colour is well within the range found in *D. assamensis*. The records of *D. neoassamensis* from Thailand by Tagawa (1956) and Tagawa & Iwatsuki (1967) (specimens in KYO!) are *D. erythrosora* (D. Eaton) Kuntze.

48. Dryopteris subtriangularis (C. Hope) C. Chr. **Fig. 53**

Index filic.: 296 (1905). – *Nephrodium subtriangulare* C. Hope in *J. Bot., Lond.* **28**: 327 (1890). – *Lastrea filix-mas* var. *subtriangularis* (C. Hope) Beddome, *Suppl. ferns Brit. Ind.*: 56 (1892). Type: India, above Laukot, southern face of the Khasi Hills, 800 ft, September 1888, *Gustav Mann* (P! – lectotype, selected here; E! – isolectotype).

Dryopteris subassamensis Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 451 (1938). Type: China, Yaoshan [Lo-shiang, Ping-nam Hsien], Kwangsi, 1100 m, 11 June 1928, *Sin* 445 (PE! – lectotype, selected here; PE! – isolectotypes).

Dryopteris uropinna M. Price in *Gdns' Bull., Singapore* **30**: 244, pl. 1 (1977). Type: Philippines, Luzon, Ilocos Norte, Mt. Burnay, well-lighted sheltered slope in mossy forest, *c.* 1900 m, 3–5 December 1975, *M. G. Price* 3364 (MICH! – holotype; BM! – isotype).

Fronds small to medium-sized (up to *c.* 55 cm long). Stipe long, about the same length as the lamina, thin, the base dark brown and somewhat densely clothed with stiff, ± long, very narrowly linear-lanceolate, very dark blackish-brown or black, glossy scales, which rapidly become very small and scattered further up and are ± absent from the upper stipe and rachis. Lamina twice pinnate, widely triangular-lanceolate, or deltate (up to *c.* 28 cm wide), with a somewhat caudate apex, widest at the base, bearing up to *c.* 18 pairs of ± contiguous or slightly separate pinnae; pinnae elongated triangular-lanceolate with ± caudate apices, somewhat stiffly herbaceous but thin, mid- or somewhat dark green and smooth above, bearing scattered, very small, mid-brown, bullate scales on the underside of the costae (particularly near their apices) and costules, and with up to *c.* 15 pairs of somewhat large pinnules; pinnules wide, though longer than broad, widely lanceolate or ± rectangular, stalked near the bases of the pinnae, but becoming narrowly attached to the pinna-costa before half-way up each pinna, and becoming widely attached (adnate) above and fused to each other at their bases near the pinna-apex, ± parallel-sided, unlobed at the margin in the upper pinnules, but toothed, with small, acute teeth, lower pinnules becoming lobed up to half their depth on each side, pinnule-lobes contiguous, somewhat wide, and markedly rectangular, each bearing an acute tooth at its acroscopic corner, pinnule-apices wide, rounded-truncate or rounded, bearing a few, somewhat insignificant, small, acute teeth, pinnules on the basiscopic side of the lowest pinnae slightly developed and longer than those on the acroscopic side, the lowest basiscopic pinnule on the lowest pinna sometimes a little shorter than the next, but generally the same size or slightly longer. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule, midway between the centre and the margins, bright pink when young, becoming a normal black when the spores ripen and brown when they are shed, indusiate; indusia ± flat or very slightly curved over the sorus, very slightly thick, becoming mid-brown, lifting and shrivelling somewhat, but mostly persistent. Spores irregular, with fully formed and abortive spores.

Cytology: Triploid apomict (SW. China: Gibby (1985)).

Ecology: A species of the lower-middle forest zone, growing on the ground, usually on banks beside streams, from *c.* 250–1300 m alt.

Range: India (Assam); Burma; China (Yunnan, Szechuan, Kweichow, Kwangsi); Taiwan; Thailand; N. Vietnam; Philippines. A south-east Asian element.

Range in the Indian subcontinent: **75** Subansiri Frontier District, Ziro, 6 January 1961, *S. Chaudhury* 19871 (CAL!), and Ziro valley and nearby village, 30 September 1959, *G. Panigrahi* 19866 (ASSAM!); **82** Cachar, 1864, *J. Hutton* (MANCH!); **83** Stream by path from Ladmowphlang down to large ravine below and west of it, 2 km north of Sohrarim, north of Cherrapunji, Khasi Hills, 1 December 1978, *C. R. Fraser-Jenkins* 8988–8991 (BM!), 8988–9010 (H!).

Notes: Ching (1938) cited *Clarke* 18871 as the type of *Dryopteris subtriangularis*, but although this specimen is not the type, as pointed out by Price (1977), it is nevertheless *D. subtriangularis*, despite it not agreeing exactly with Hope's description of a specimen with reduced lowest pinnules on the lowest pinnae. As a result of Hope's description and Ching's mistake, Price (1977) separated his *D. uropinna* from *D. subtriangularis*, but the Philippine plants are not different from the Assamese ones.

Fig. 53 *Dryopteris subtriangularis*. India, Assam, Jaintia Hills, September 1890, *Gustav Mann* (BM). Scale line = 1 cm.

D. tenuicula C. Matthew & Christ (synonyms: *D. submarginata* Rosenstock, *D. indusiata* (Makino) Makino & Yamamoto ex Yamamoto) from Burma, China (Szechuan, Kweichow, Kwangsi, Hunan, Hupeh, Kiangsi, Kwangtung, Chekiang), Taiwan, and Japan, is near the present species but differs in its mid- to very dark brown or blackish stipe-base scales, larger, more elongated frond, usually reduced lowest pinnules in the lowest pinnae, and more deeply lobed pinnules with more acute apices and slightly more square and separate lobes; in larger plants the lowest pinnae, which are markedly opposite, are often slightly deflexed. A report of *D. subtriangularis* from Yakushima, S. Japan by Price (1977) refers to this species.

D. subassamensis Ching represents small and poorly developed plants of *D. subtriangularis*. It is significant that Ching cites an adult plant from the same area (Lu-chen Hsien) in Kwangsi as *D. subtriangularis*.

Section 2. Variae Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 196 (1986).

49. Dryopteris varia (L.) Kuntze **Fig. 54**

Revis. gen. pl. **2**: 814 (1891). – *Polypodium varium* L., *Sp. pl.* **2**: 1090 (1753). – *Aspidium varium* (L.) Sw. in *J. Bot. Göttingen* **2** (1): 35 (1801). – *Nephrodium varium* (L.) Desv. in *Mém. Soc. linn. Paris* **6** (3): 259 (1827), nom. illeg. (Art. 64.1), non C. Presl (1825). – *Polystichum varium* (L.) C. Presl, *Epimel. bot.*: 57 (1849). – *Lastrea varia* (L.) T. Moore, *Index fil.*: 107 (1858). Type: China, *Osbeck* (Not in BM, K, LINN, not in Herb. Linn. in 1753).

Lastrea opaca Hook. in *Hooker's J. Bot.* **9**: 339 (1857). – *Aspidium opacum* (Hook.) Benth., *Fl. Hongk.*: 456 (1861). Type: Hong Kong and mainland N.W. of Hong Kong, *J. C. Bowman* (K! – lectotype, selected here).

Nephrodium coriaceum C. Hope in *J. Bot., Lond.* **28**: 328 (1890). Type: India, Kapili Hot Springs, North Cachar Hills, Assam, 1000 ft, February 1890, *Gustav Mann* (K! – lectotype, selected here; BM!, DD!, E!, K!, P!, PE! – isolectotypes).

Dryopteris yabei Hayata in *J. Coll. Sci. imp. Univ. Tokyo* **30**: 424 (1911). – *Dryopteris yabei* forma *typica* H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 59 (1939 ['1938']), nom. inval. (Art. 24.3). Type: Taiwan, Kushaku and Shintengai, 16 October 1899, *K. Miyake* (TI – holotype).

Polystichum hololepis Hayata, *Icon. pl. formos.* **5**: 332 (1915). – *Dryopteris yabei* var. *hololepis* (Hayata) H. Itô in *Bot. Mag., Tokyo* **50**: 128 (1936). Type: Taiwan, Taihoku, *Takeo Ito & S. Fujii* (TI – holotype).

Dryopteris matsuzoana Koidz. in *Bot. Mag., Tokyo* **39**: 15 (1925). – *Dryopteris yabei* var. *matsuzoana* (Koidz.) H. Itô in *Bot. Mag., Tokyo* **50**: 128 (1936). Type: Japan, Shikoku, prov. Iyo, Minamiuwagori, Uchimimura, Shimonadema and Jinadamura, 13 October 1923, *Matsuzo Ogata* (KYO – holotype).

Dryopteris ogawae ['*ogawai*'] H. Itô in Nakai, *Iconogr. pl. As. orient.* **1**: 18, pl. 9 (1935). – *Dryopteris yabei* var. *ogawae* (H. Itô) H. Itô in *Bot. Mag., Tokyo* **50**: 128 (1936). – *Dryopteris yabei* forma *ogawae* (H. Itô) H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 59 (1939 ['1938']). Type: Japan, Honshu, prov. Awa, in monte Kiyozumiyama, April 1933, *M. Kishida* (TI – holotype).

Fronds medium-sized (up to *c.* 75 cm long). Stipe long, about the same length as the lamina, stiff, ± thin, the base thicker and densely clothed with long, narrowly lanceolate, dark brown or blackish, stiff, ± adpressed scales, which become all brown, smaller, and markedly narrow or ± hair-like, with long, narrow apices, but remain somewhat dense further up and on the rachis, extending onto the pinna-costae. Lamina becoming three times pinnate near the base in large fronds, ± triangular-lanceolate, or somewhat ovate-lanceolate (up to *c.* 30 cm wide), not tapering below, bearing few (up to *c.* 23 pairs) contiguous or overlapping pinnae, the apical part of the lamina being somewhat contracted; pinnae deltate to narrowly triangular-lanceolate with caudate apices, stiffly coriaceous and thick, pale- to mid-green above, the lower surface of the costae and costules bearing small, ± scattered, scarcely bullate, mid- to light brown scales, mixed with fibrils, and bearing many (up to *c.* 22 pairs) ± small lobes or pinnules; pinnules or lobes ± long, narrowly triangular-lanceolate with sloping sides, stalked in the lower parts of the pinnae but narrowly attached further up and becoming widely attached (adnate) to the pinna-costa above, deeply pinnatifidly lobed, or becoming pinnatisect into widely lanceolate pinnulets, except in the pinnules in the upper parts of the pinnae which are only shallowly lobed, pinnule-apices markedly caudate and acute, bearing small, insignificant, acute teeth, pinnules on the basiscopic sides of the lowest few pairs of pinnae developed and longer than those on the acroscopic side, especially at the base of the lower pinnae where the basal pair of pinnules are often markedly longer than the next on both acroscopic and basiscopic sides, the lowest basiscopic pinnule on the lowest pinna often being markedly the longest; pinnulets or pinnule-lobes with acute apices, often bearing small, acute teeth and sometimes very shallow, pointed lobes around their sides, and with small, acute teeth at their apices. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule or pinnulet, sometimes midway between the centre and margins, but more usually becoming submarginal in specimens with wider, coarser segments, indusiate; indusia ± flat, thin, lifting and shrivelling considerably and mostly deciduous. Spores irregular, with fully formed and abortive spores.

Cytology: Diploid apomict (Japan: Hirabayashi (1966, 1967, 1974). Taiwan: Tsai & Shieh (1975)), and triploid apomict (SE. China and Hong Kong: Gibby (1985). Japan: Mitui in Fabbri

Fig. 54 *Dryopteris varia.* India, Assam, North Cachar, Kapili Hot Springs, February 1890, *Gustav Mann* (BM). Scale line = 1 cm.

(1965). Mitui (1966, 1968). Hirabayashi (1970)). Also reported as tetraploid (Taiwan: Tsai & Shieh (1975)).

Ecology: A species of the lower-middle forest zone, growing on the ground, often on banks in the forest, from *c.* 300–1000 m alt.

Range: India (Assam, rare); ? Burma; China (Yunnan, Szechuan, Kweichow, Hunan, Kiangsi, Chekiang, Kiangsu, Kwangtung, Fukien, Kwangsi); Macau; Hong Kong; Taiwan; Korea and Cheju Do; Japan; N. Vietnam; Philippines. Probably best considered a south-east Asian element, with its range extended throughout eastern Asia.

Range in the Indian subcontinent: **82** Kapili Hot Springs, North Cachar Hills, 1000 ft (300 m), February 1890, *G. Mann* (BM!, DD!, E!, K!, P!); **83** Garampani, E. Khasia, 30 October 1956, *G. Panigrahi* 4214 (ASSAM!).

Notes: Dryopteris varia and other similar members of section *Variae* are often confused with the genus *Arachniodes* (often under *Polystichum*) because of the caudate, more or less pointed pinna and pinnule apices, and more or less pointed pinnulets. However, the resemblance is only superficial as *Arachniodes* does not have weakly bullate or bullate scales, and has pinnules with a

more developed and more acutely pointed basal acroscopic pinnulet, segments ending in a single stiff tooth, and a more coriaceous, glossy lamina.

The degree of dissection in *D. varia* varies considerably with the size of the plant and growing conditions, and has led to it being redescribed several times, as the synonymy shows. However, it is likely that the species, as here construed, consists of a complex with more than one ploidy existing and may perhaps be separable into distinct taxa on further careful cytotaxonomic investigation.

Subgenus 3. Nephrocystis (H. Itô) Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 197 (1986).

Section 1. Purpurascentes Fraser-Jenkins in *Bull. Br. Mus. nat. Hist.* (Bot.) **14** (3): 197 (1986).

50. Dryopteris pulvinulifera (Beddome) Kuntze **Fig. 55**

Revis. gen. pl. **2**: 813 (1891). – *Lastrea pulvinulifera* Beddome, *Ferns Brit. India* **2**: 333, pl. 333 (1870). – *Nephrodium pulvinuliferum* (Beddome) Baker in Hook. & Baker, *Syn. fil. ed. 2.*: 500 (1874). Type: India, Himalayas, [*Jerdon*], Herb. Beddome, May 1869 (K! – lectotype, selected here).

Lastrea pulvinulifera var. *zeylanica* Beddome, *Suppl. ferns S. Ind.*: 17 (1876). – *Lastrea sparsa* var. *zeylanica* (Beddome) Beddome, *Handb. ferns Brit. India*: 254 (1883). Type: Sri Lanka, 'Ceylon', [*G. Wall*] (K! – lectotype, selected here).

Nephrodium sparsum var. *squamulosum* C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 524 (1880). Type: India, Sohra Rim, 5000 ft, Khasia, 16 October 1872, *C. B. Clarke* 19157A (K! – lectotype, selected here; P! – isolectotype).

Dryopteris harae H. Itô in Hara, *Fl. e. Himalaya*: 476, pl. 26 (1966). Type: India, Sikkim, Yoksam-Bakkim, 1700–2200 m, 18 May 1960, 1st Japanese Expedition to the East Himalaya, *H. Hara, H. Kanai, G. Murata, M. Togashi & T. Tuyama* 2355 (TI, photograph! – holotype; BM!, K! – isotypes).

Dryopteris reholttumii M. Price, *Fiddlehead Forum* **8** (3): 19 (1981), nom. nud. (Art. 32.1). Specimens in MICH!.

Fronds large (up to *c.* 90 cm long), arising together from just below the widened apex of a thin, creeping rhizome, hanging over and between rocks. Stipe long, up to *c.* the same length as the lamina, pale, ± thin, the base curved just above the point of attachment to the rhizome and bearing a dense tuft of long, undulated, or crinkled, very narrowly lanceolate, pale- or somewhat russet-brown, glossy scales, the rest of the stipe ± glabrous or bearing scattered, narrowly-lanceolate, dark scales, the rachis, costae and costules ± glabrous apart from a somewhat dense covering of very small, or minute, and extremely short, dark brown, hair-like scales, particularly near the points of insertion of the pinna-costae to the rachis. Lamina becoming four times pinnate below, deltate, or widely triangular-lanceolate (up to *c.* 50 cm wide), not narrowed at the base, bearing up to *c.* 18 pairs of contiguous or overlapping pinnae; pinnae ± deltate to elongated triangular-lanceolate, herbaceous, or sometimes very slightly crispaceous when growing in an exposed place, dark green above (pale yellowish-green when young), bearing minute, dark brown, hair-like scales on the costae, bearing many (up to *c.* 16 pairs) somewhat large pinnules; pinnules contiguous or distant, long, elongated triangular-lanceolate, stalked, pinnate, apices acutely pointed and bearing a few, insignificant, small, acute teeth, pinnules on the basiscopic side of the lowest pair of pinnae somewhat developed and larger than those on the acroscopic side, particularly towards the base of the pinnae; pinnulets ± contiguous, or slightly distant, ± long, stalked, pinnate, or becoming deeply pinnatifidly lobed further up the pinnae, somewhat asymmetrical about their axes, the lobes more developed, wider and longer on their acroscopic side, apices acutely pointed and bearing a few insignificant, small, acute teeth; pinnulet-lobes or pinnulet-segments (ultimate segments, of the fourth order) slightly longer on the acroscopic side of the pinnulets and smaller and more sloping on the basiscopic side, ± asymmetrically elliptical and narrowed to their bases and their acute-pointed apices, ending in a few small, acute teeth. Sori small, not crowded, in two short rows, one on each side of the centre of each segment, midway between the centre and margins, indusiate; indusia ± flat or slightly curved over the edges of the sori, thin, lifting, becoming brown and shrivelling considerably, mostly deciduous. Spores regular.

Fig. 55 *Dryopteris pulvinulifera.* India, West Bengal, Darjeeling, 12 November 1978, *C. R. Fraser-Jenkins* 8440 (BM). Scale line = 1 cm.

Cytology: Diploid sexual (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal*, August 1954 (PAN 1221–1226!) and *D. S. Loyal* 39, August 1955 (PAN 1227!) and July 1958 (PAN 2391!)).

Ecology: A species of the mid-level forest zone, growing on steep banks or rock surfaces, often protected by bushes, from *c.* 1700–2500 m alt.

Range: India (E. Himalaya in Sikkim and N. Assam; Assam); E. Nepal; Sri Lanka; ? Bhutan; China (Yunnan); Philippines. A Sino-Himalayan species of the east Himalayan sort, also occurring in Sri Lanka and the Philippines and thus showing some features of a south-east Asian element.

Range in the Indian subcontinent: **62** Kasuwa, Arun river, 1974, *H. Emery & E. W. Cronin* F-1228 (BM!), and Mewa Gorge, 8200 ft (2500 m), 3 December 1971, *R. L. Fleming* 2129 (K!); **64** 1 km along from north end of Tensing Norgay road, towards Aloo Beri, east side of Darjeeling ridge, *c.* 2200 m, 20 November 1978, *C. R. Fraser-Jenkins* 8728, 8729 (BM!), 8728, 8730–8735 (H!); **65** Yoksam to Bakkim, 1700–2200 m, 18 May 1960, *H. Hara et al.* 2355 (BM!, K!); **74** Kameng (ASSAM!); **79** Chukka Mts, Kohima (Naga) (CAL!), and Borsilla [= Barsala, nr Jorhat], 1874, '*A soldier*' (BM!); **82** Cachar, 1864, *J. Hutton* (MANCH!); **83** Stream gulley, below Peak Lodge, 10 km above Shillong on road to the Peak, Khasi Hills, 1800 m, 24 November 1978, *C. R. Fraser-Jenkins* 8794 (BM!); **100** Ceylon, Herb. *G. Wall* 44/94 (P!).

Notes: Dryopteris pulvinulifera is somewhat unusual in its occurrence in the Himalaya and Sri Lanka but apparent absence from S. India, though some other ferns also show this distribution pattern.

Clarke (1880) erroneously applied the name *Nephrodium pulvinuliferum* to what was, in fact, *Nephrodium squamisetum* Hook. (= *Nothoperanema squamiseta* (Hook.) Ching) and redescribed the present species as var. *squamulosum* of *Nephrodium sparsum*. He later (1882) corrected this. His mistake arose because, in the protologue, Beddome (1870) himself had a mixed concept, and described and illustrated the stipe-base and pinnule-shape of the present species, combined with the numerous, more or less long rachis scales of *Nothoperanema*. He did not correct this error and separate the *Nothoperanema* species until 1876. The lectotype chosen here from a mixed type sheet at Kew is the specimen labelled '99. Lastrea pulvinulifera Bedd., fronds 4–5 ft. long'; a second sheet at Kew, labelled 'Nephrodium pulvinuliferum Baker, L. n. sp. near sparsa but scaly. Sikkim. Dr. Jerdon', is the *Nothoperanema* species. The label of this sheet, which is written in the same hand and way as that of the type sheet, shows that the type was also collected by Jerdon, as indicated in the protologue of *Lastrea pulvinulifera*.

Section 2. Nephrocystis

51. Dryopteris hasseltii (Blume) C. Chr. **Fig. 56**

Index filic.: 269 (1905). – *Polypodium hasseltii* Blume, *Fl. Javae* fasc. 40: 195, pl. 92 (1851 ['1828']). – *Phegopteris hasseltii* (Blume) Mett. in *Abh. senckenb. naturforsch. Ges.* **2** (2): 297 (1858) (= *Farngatt.* **4**: 13 (1859)). – *Rumohra hasseltii* (Blume) Ching in *Sinensia, Shanghai* **5**: 61 (1934). – *Athyrium hasseltii* (Blume) Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **10**: 6 (1940). – *Polystichopsis hasseltii* (Blume) Holttum, *Fl. Malaya* **2**: 487 (1954). – *Byrsopteris hasseltii* (Blume) C. Morton in *Am. Fern J.* **50**: 154 (1960). – *Arachniodes hasseltii* (Blume) Ching in *Acta bot. sin.* **10**: 258 (1962). – *Acrorumohra hasseltii* (Blume) Ching in *Acta phytotax. sin.* **9** (4): 385 (1964). Type: Java, Karanjo Marat, *Zippel.* (L! – holotype).

Polypodium anisopterum Kunze in *Bot. Ztg* **6**: 118 (1848). Type: Java, 'In caffetis rara. Zollinger no. 1466, Pl. Javanica' (L! – holotype).

Nephrodium obovatum Baker in *J. Bot., Lond.* **28**: 265 (1890). – *Lastrea obovata* (Baker) Beddome, *Suppl. ferns Brit. Ind.*: 60 (1892). – *Dryopteris obovata* (Baker) C. Chr., *Index filic.*: 280 (1905). Type: Vietnam, Tonkin, Forêts du Mont-Bani, 1887, *B. Balansa* 1815 (K! – holotype).

Polypodium laserpitiifolium Scortech. ex Beddome in *J. Bot., Lond.* **25**: 324 (1887). – *Phegopteris laserpitiifolia* (Scortech. ex Beddome) Beddome, *Suppl. ferns Brit. Ind.*: 84 (1892). – *Dryopteris laserpitiifolia* (Scortech. ex Beddome) C. Chr., *Index filic.*: 273 (1905), nom. illeg. (Art. 64.1), non (Mett.) Kuntze (1891). Type: Malaya, Perak, *Revd Father Scortechini* (K! – holotype).

Dryopteris sparsa var. *raapii* Alderw., *Malayan ferns*: 197 (1908). Type: Java, Tioblong, 26 February 1909, *Raap* 3 (L! – holotype; K! – isotype).

Dryopteris psilosora Tag. in *Acta phytotax. geobot. Kyoto* **2**: 191 (1933). Type: Japan, Ryukyu, Okinawa Isl., Nakagami Distr., 27 May–3 June 1923, *G. Koidzumi* (TI – holotype; L! – isotype).

Dryopteris adiantoides T. Suzuki in *J. Jap. Bot.* **11**: 644, fig. 1 (1935). Type: Taiwan, 'in laurisilvis montis

Sendan-yama, praef. Taihoku-Syu', 23 February 1935, *Suzuki-Tokio* 7486 (Herb. Imp. Univ. Taihoku, Taiwan – holotype, photograph!).

Dryopteris hatusimae H. Itô in *Bot. Mag., Tokyo* **67**: 216, fig. 2 (1954). Type: Caroline Islands, Ponape, Nipit, July 1939, *S. Hatusima* 11085 (TI! – holotype, only photograph seen).

Fronds medium to large (up to *c.* 120 cm long). Stipe long, as long as, or longer than, the lamina, pale, slightly thin, the base bearing scattered, thick, widely-lanceolate, dark brown or blackish-brown scales, scales absent further up and on the rachis. Lamina becoming four times pinnate

Fig. 56 *Dryopteris hasseltii.* Taiwan, Prov. Taichin, Keitan, 9 December 1928, *M. Ogata* 3c (BM). Scale line = 1 cm.

near the base in larger fronds, elongated triangular-lanceolate (up to *c.* 36 cm wide), not, or hardly, narrowed at the base, bearing up to *c.* 17 pairs of ± distant pinnae; pinnae ± narrowly triangular-lanceolate, herbaceous, smooth, pale- to mid-green above, glabrous, bearing many (up to *c.* 16 pairs) large pinnules; pinnules ± long, ± contiguous, triangular-lanceolate, stalked, deeply pinnatifid further up the pinna, but pinnate below, pinnule-apices obtusely rounded and bearing a few acute, ± aristate, stiff teeth, pinnules on the basiscopic side of the lowest pair of pinnae developed and longer than those on the acroscopic side, especially the basal pair; pinnulets or pinnule-lobes wide, somewhat rectangular, but with markedly rounded apices, bearing a few scattered, ± long, acute, ± aristate, stiff teeth around the margins and apices, pinnule-lobes or pinnulets on the acroscopic side of the pinnules more developed, longer and wider than those on the basiscopic side, especially the basal ones, in large plants the pinnulets lobed and even becoming pinnatisect into fourth-order segments near the base of the frond. Sori small, not crowded, in two rows, one on each side of the centre of the segments, midway between the centre and margins, exindusiate. Spores regular.

Cytology: Unknown.

Ecology: A species of the lower mid-level forest zone, growing on the ground, from *c.* 800–1500 m alt.

Range: India (Assam, rare); China (Yunnan, Hainan); Taiwan; N. Vietnam; S. Japan; Thailand; Philippines; Malaya; Moluccas; Sumatra; Java; New Guinea; New Britain; Caroline Islands (Ponape). A south-east Asian element.

Range in the Indian subcontinent: **78** Nakum Forest, Lakhimpur, December 1889, *G. Mann* (BM!), and Digboi, Nakum Forest, January 1891, *G. Mann* (DD!, K!, L!, P!). Also: 'India', *W. Griffith* (BM!).

Notes: Dryopteris hasseltii is very rare in the Indian subcontinent and has been overlooked, both there and elsewhere, or has been placed in *Acrorumohra*, *Arachniodes*, or even *Polystichopsis*. Its relationship to *D. sparsa* is obvious, though it can be separated easily by its dark, lanceolate scales confined to the stipe base, and more dissect frond with a thinner lamina and more rounded, obtuse segments.

A report of this species from Nepal (Itô, Tagawa & Iwatsuki, 1966) was in error for *D. sparsa* (see Iwatsuki, 1975). A closely similar species from Melanesia (Bougainville (Papua New Guinea), Guadalcanal (Solomon Islands), Espiritu Santo and Aneityum (Vanuatu), New Caledonia, and Fiji) differs in its thinner lamina with more acute pinnule apices and more toothed and acutely-lobed ultimate segments. It is either conspecific or a vicariant taxon known as *D. aneitensis* (Hook.) C. Chr. (synonyms: *D. layardii* (Baker) C. Chr., *D. gillespiei* Copel., and *D. odontophora* Copel.; all types seen by the author), which must be considered doubtfully distinct pending further investigation.

52. **Dryopteris sparsa** (Buch.-Ham. ex D. Don) Kuntze **Figs 57–58**

Revis. gen. pl. **2**: 813 (1891). – *Nephrodium sparsum* Buch.-Ham. ex D. Don, *Prodr. fl. nepal.*: 6 (1825). – *Aspidium sparsum* (Buch.-Ham. ex D. Don) Sprengel, *Syst. veg. ed. 16* **4** (1): 106 (1827). – *Lastrea sparsa* (Buch.-Ham. ex D. Don) T. Moore, *Index fil.*: 87, 104 (1858). – *Polystichum sparsum* (Buch.-Ham. ex D. Don) Keys., *Polyp. herb. bunge.*: 43 (1873). – *Dryopteris sparsa* var. *sparsa* in Seriz., *J. Jap. Bot.* **46**: 278 (1971). Type: Nepal, Suembu, 15 May 1802, *Dr Buchanan* (BM! – holotype).

Aspidium oppositum Wallich, *Num. List*: no. 7080 (1832), nom. nud. (Art. 32.1). Specimens in K-W!

Aspidium catophoron Kunze in *Bot. Ztg* **6**: 262 (1848). Type: Java, 'In sylvis M. Tamp. + 3000'', 4 January 1845, *Zollinger* (625.Z.) (L! – lectotype, selected here; L! – isolectotype).

Aspidium weigleanum Kunze in *Linnaea* **24**: 284 (1851). Type: S. India, *Kurr* 38, *Weigle & Schaeffer* 27a (LZ – syntypes, destroyed?).

Aspidium densum Wallich, *Num. List*: no. 390 (1828), nom. nud. (Art. 32.1). – Wallich ex Mett. in *Abh. senckenb. naturforsch. Ges.* **2** (2): 349 (1858) (= *Farngatt.* **4**: 65 (1859)), nom. illeg. (Art. 63.1).

Nephrodium sparsum var. *latisquama* C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 524 (1880). Type: India, Nakum, Luckimpore, 300 ft, 12 April 1885, *C. B. Clarke* 37824 C (P! – lectotype, selected here; K! (*Clarke* 37824A) – isolectotype).

?*Dryopteris sparsa* var. *ryukyuensis* Seriz. in *J. Jap. Bot.* **46**: 279 (1971). Type: Japan, Kofukujidani, Sumiyo-mura, Ryuku, *S. Serizawa* 11698 (TNS – holotype).

Dryopteris parasparsa Ching & S. K. Wu in Cheng-yih Wu, *Fl. xizangica* **1**: 267, fig. 64, 1–2 (1983). Type: Tibet, Me To (Medog), 800 m, 19 August 1974, *Chinghai-Xizang Expedition* 74-4374 (PE! – holotype; PE! – isotype).

Misapplied names: Nephrodium purpurascens sensu Hook. (1862); *Dryopteris hasseltii* sensu Itô, Tagawa & Iwatsuki (1966).

Fronds medium-sized or ± large (up to *c.* 100 cm long). Stipe long, *c.* ⅔ the length to the same length as the lamina, pale, slightly thin, the base bearing somewhat scattered, thin, ovate or ovate-lanceolate, pale brown scales, those towards the base usually with a vaguely defined, slightly darker central and basal area, scales absent from the top of the stipe and the rachis. Lamina becoming three times pinnate below in larger plants, elongated triangular-lanceolate (up to *c.* 30 cm wide), not, or hardly, narrowed at the base, bearing up to *c.* 20 pairs of usually slightly distant pinnae; pinnae ± narrowly triangular-lanceolate, often with caudate apices, slightly stiffly herbaceous, or very slightly crispaceous, smooth and pale- to mid-green above, ± glabrous, bearing up to *c.* 18 pairs of large pinnules; pinnules ± long, ± contiguous, or slightly separate, ± narrowly triangular-lanceolate, or lanceolate, stalked towards the bases of the pinnae, but becoming more widely attached to the pinna-costae further up the pinnae, shallowly

Fig. 57 *Dryopteris sparsa* (acute-segmented). India, West Bengal, Darjeeling, Lebong, 19 November 1978, *C. R. Fraser-Jenkins* 8651 (FR). Scale line = 1 cm.

lobed, but becoming deeply lobed in the lower pinnae and pinnatisect at the base of the lowest pinnae in larger plants, pinnules sloping and asymmetrical, the lobes on the acroscopic side of the pinnules being more developed, longer and wider than the more obliquely inserted ones on the basiscopic side, the acroscopic base of each pinnule usually being somewhat auriculate, pinnule-apices varying from acutely pointed to obtusely pointed, or occasionally somewhat rounded, bearing a few acute, ± aristate, stiff teeth, pinnules on the basiscopic side of the lowest pair of pinnae developed and longer than those on the acroscopic side, especially the basal pair; pinnule-lobes or pinnulets ± widely lanceolate, their apices varying from rounded to obtusely pointed, bearing a few scattered, ± long, acute, ± aristate, stiff teeth around the margins and apices. Sori small, not crowded, in two rows, one on each side of the centre of each segment, midway between the centre and the margins, indusiate; indusia ± large, slightly curved over the top of the sorus, thin, lifting and shrivelling markedly and mostly deciduous. Spores regular.

Cytology: Diploid sexual (W. Himalaya: Mehra & Khullar (1980), voucher specimens, *S. P. Khullar* 155, September 1967 (PAN 6030!, 6069!). E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal*, August 1958 (PAN 2303!) and *D. S. Loyal* 7 (PAN 2238!). Taiwan: Hirabayashi (1974). Malaya: Manton (1955)). Also tetraploid sexual (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimens, *D. S. Loyal* 8

Fig. 58 *Dryopteris sparsa* (obtuse-segmented). India, West Bengal, Darjeeling, Lebong, 19 November 1978, *C. R. Fraser-Jenkins* 8646 (FR). Scale line = 1 cm.

(PAN 2239!) and August 1958 (PAN 2302!). Nepal: Roy, Sinha & Sakya (1971). S. India: Ghatak (1962). Ghatak (1963), sub var. *viridescens*, in error. Abraham, Ninan & Mathew (1962). Bhavanandan (1981). Japan: Kurita (1966). Hirabayashi (1966, 1974). Mitui (1972)). Also triploid apomict (Taiwan and Japan: Hirabayashi (1974)). Also a sterile triploid hybrid (E. Himalaya: Loyal in Mehra (1961). Mehra & Loyal (1965), voucher specimen, *D. S. Loyal*, 2 August 1958 (PAN!)).

Ecology: A species of the lower and mid-level forest zone, growing on the ground under bushes or trees and usually on slopes, from *c.* 100–2700 m alt.

Range: India (central and eastern part of the W. Himalaya; E. Himalaya in Sikkim and N. Assam; Assam; mountains of central and south India); Sri Lanka; Nepal; Bhutan; Burma; SE. Tibet; China (Yunnan, Szechuan, Kweichow, Kwangsi, Kwangtung, Chekiang, Anwhei, Kiangsi, Hunan, Fukien, Hainan, Shensi); Hong Kong; Taiwan; Japan; Cambodia; N. Vietnam; Malaya; Thailand; Philippines; Borneo; Sumatra; Java; Sumbawa; Flores; New Guinea; Australia (Queensland). A south-east Asian element.

Range in the Indian subcontinent: **37** Towards Hutoo, *W. Griffith* (K!); **40** Phaidi, east of Landour, 5–6000 ft (1520–1830 m), 22 September 1881, *J. F. Duthie* (DD!, P!); **42** Mussoorie, 1877, *J. F. Duthie* (BM!); **45** Tiri Garhwal, 1878–1879, *Col. Herschell* 120 (BM!); **48** Near Ascot, 4–5000 ft (1220–1520 m), 28 September 1884, *J. F. Duthie* (BM!, DD!), and Thal, 1200 m, September 1967, *S. P. Khullar* 155 (PAN 6030, 6069!); **55** Andhi Khola, 2000 ft (610 m), 8 January 1950, *R. L. Fleming* 858 (BM!), and 13 miles south-east of Baglung, 3000 ft (910 m), 12 November 1949, *R. L. Fleming* 903 (BM!); **56** Palpa, nr Tansing, 4000 ft (1220 m), 10 October 1959, *J. D. A. Stainton, W. R. Sykes & L. H. J. Williams* 8866 (BM!); **58** Nagarjum, 5000 ft (1520 m), 3 June 1969, *P. Pradhan & M. S. Gurung* 8682, 8683, 8883 (KATH!); **60** Seduwa, 1974, *H. Emery & E. W. Cronin* F-1202 (BM!); **62** Bir Gaon (1600 m) to Saju Khola (1400 m), 1 July 1972, *H. Kanai et al.* (KATH!); **63** Sangure ridge, 1889 m, 4 October 1978, *R. L. Fleming* 2621A (KATH!); **64** Forest below Lebong, north of Darjeeling, 1550 m, 19 November 1978, *C. R. Fraser-Jenkins* 8626, 8628–8630, 8633 (BM!), 8646, 8651 (FR!), 8627–8634, 8636, 8637, 8639, 8640, 8642, 8643, 8647–8650, 8652–8660, 8662 (H!); **65** Yoksar, 3000 ft (910 m), *J. D. Hooker* (K!); **68** Tinlegang (1750 m) to Gon Chungnang (1600 m), 5 May 1967, *H. Kanai et al.* 14831 (BM!, KATH!); **72** Pintsogong, 27° 15′N, 91° 34′E, 5000 ft (1520 m), 21 November 1938, *F. Ludlow, G. Sherriff & G. Taylor* 6750 (BM!); **74** Kameng Frontier Division, Parila Flat, 8850 ft (2695 m), 2 April 1957, *G. Panigrahi* 6387 (ASSAM!); **76** Siang Frontier Division, Pangu to Minguing, 16 November 1958, *G. Panigrahi* 17716 (ASSAM!); **77** Denning, Lohit valley, 2500 ft (760 m), 5 February 1950, *F. Kingdon-Ward* 19126 (BM!); **78** Nakum, Luckimpore, 300 ft (90 m), 17 April 1885, *C. B. Clarke* 37824A & C (K!, P!); **79** Borsilla [= Barsala, nr Jorhat], 1874, '*A soldier*' (BM!), and Nambar Forest, 1891, *G. Mann* (B!, BM!); **80** Manipur, *Dr D. B. Deb* 2904 (CAL!); **81** Lushai Hills, Aijal, 3–4000 ft (910–1220 m), 25 January 1953, *T. Rup Chand* 6722 (MICH!), and South Lushai, *Rev. Wenger* 49 (K!); **82** Mikir Hills, *J. D. Hooker* (K!); **83** Ravine, 1½ km north of Sohrarim, 9½ miles west of Umtyngar, north of Cherrapunji, south of Shillong, 1800 m, 29 November 1978, *C. R. Fraser-Jenkins* 8899, 8917 (BM!); **84** Dambu, 1000 ft (300 m), December 1888, *G. Mann* 4 (P!); **87** Bailadila, Bastar State, 3500 ft (1070 m), *H. F. Mooney* (K!), and Pachmarhi, *H. Haines* (K!); **89** 'Sillet' [Sylhet], *Wallich* (B!); **91** Mahabaleshwar, 1855, *Col. Bates* (K!); **92** Kurg, *J. D. Hooker & T. Thomson* (P!); **93** Nilgherries, *T. Thomson* (K!); **94** Anamallays, *R. H. Beddome* (K!); **95** 1½ km south-west of Kodaikanal centre on Berijam road, Palni Hills, 1100 m, 20 December 1978, *C. R. Fraser-Jenkins* 9214 (BM!); **96** Vishakapatnam, Galikonda (MH!); **98** Shevaroy Temple, south of bauxite mine and Kakasholai stream, north-west of Yercaud, Shevaroy Hills, Salem, 1600 m, 15 December 1978, *C. R. Fraser-Jenkins* 9091, 9092 (BM!), 9091, 9093–9096 (H!); **100** Midford, Ambagamuwa District, 1200 m, 29 January 1954, *W. A. Sledge* 1062 (BM!). Also, unlocated: Raitt Berar (BM!) and S. India, Brahmagiris (CAL!).

Notes: Dryopteris sparsa consists of a more or less cryptic complex containing diploid sexual and tetraploid sexual taxa, and a sterile triploid hybrid of sporadic occurrence, which is presumably formed between the diploid and the tetraploid. A triploid apomict also occurs in Japan and Taiwan, but has not so far been reported from the Indian subcontinent. This latter plant may well be, at least in part, identical to *D. platypus* (Kunze) Kuntze (= *D. melanocarpa* Hayata), or a separate taxon, though further investigation is required. It is distinguishable mainly by its much developed and slightly more dissect basiscopic pinnules on the lowest pinnae, and its wider frond base.

Most of the records of *D. sparsa* from mainland China (except the south-west in Yunnan,

Szechuan, and Kweichow, where true *D. sparsa* also occurs with *D. viridescens*) and probably almost all of them from Japan (except for the south) and Taiwan refer to another related but distinct species, *D. viridescens* (Baker) Kuntze, which has a more delicate lamina with slightly more rectangular segments and smaller, more acutely pointed lobes. However, this taxon has not yet been fully separated from *D. sparsa* by the present author, as far as its range in China and Japan is concerned. *D. viridescens* has also been reported from S. India (Ghatak, 1963) in error for *D. sparsa* and, along with another distinct species from Taiwan and Japan, *D. subexaltata* (Christ) C. Chr. (synonym: *D. hayatae* Tag.), was included within *D. sparsa* by Ching (1938), who also erroneously cited a Wallich specimen as the type of *D. sparsa*.

Within *D. sparsa* itself, Mehra & Loyal (1965) suggest that the diploid in the east Himalaya can be distinguished from the tetraploid by its narrower pinnules and more caudate pinna-apices; this morphology corresponding more with the holotype, the epithet *sparsa* referring to the sparse, narrow pinnae. However, in the localities in which they collected (as elsewhere in the Himalaya and in herbaria), their separation into two different types of morphology does not, at least yet, seem clear, even excluding hybrid plants, as there is a complete range of form between the narrow-pinnuled and the more obtuse-pinnuled plants. Therefore it may be that the two will not be taxonomically recognisable, though further investigation is obviously needed. Even the spore size of the voucher specimens of diploid and tetraploid plants is close. The morphological similarities between the two could probably be expected if the tetraploid were an autotetraploid and not an allotetraploid (a situation so far unknown in *Dryopteris*, but obviously not impossible). However, Loyal's findings (Mehra & Loyal, 1965) of only a small number of trivalents in the triploid hybrid at meiosis, and only bivalents in the tetraploid, do not provide any fully conclusive evidence either for or against this, and more research is needed. The description of new species within this complex is therefore undesirable until thorough investigation has been carried out to clarify the whole situation. *D. parasparsa* Ching & S. K. Wu, for example, certainly matches the common, more obtuse-segmented plant from the Himalayas, already described several times as *Aspidium catophoron* Kunze, *A. weigleanum* Kunze, and *A. densum* Wallich ex Mett.

In Java, Sumatra, the Philippines, Taiwan, and Japan (and also reported from Burma by Beddome (1867), probably in error), as well as *D. sparsa*, another species occurs with which it is often confused. This is *D. platypus* (Kunze) Kuntze, erroneously placed into *Polystichum* or *Arachniodes* by Christensen (1906) and others. The type (L!) shows it to be larger and more dissect than *D. sparsa*, with the segments more triangular, with narrower, more acute lobes, and the sori more crowded near the segment midribs.

D. cacaiana Tag. (synonym: *D. yakusilvicola* Kurata) from S. Japan, Taiwan and the Philippines, and *D. sabae* ['*sabaei*'] (Franchet & P. A. L. Savat.) C. Chr. from Japan are other distinct species sometimes confused with *D. sparsa*.

53. Dryopteris yoroii Seriz. **Fig. 59**

in *J. Jap. Bot.* **46** (1): 20, fig. 1b (1971). Type: Taiwan, between Yushankou and Paiyun cottage, Mt Yushan, pref. Chia-yi, 8 August 1968, *Reiko Yoroi* s.n. (TNS 401323! – holotype).

Aspidium nitidulum Wallich, *Num. List*: no. 392 (1828), nom. nud. (Art. 32.1). – *Aspidium nitidulum* Wallich ex Kuhn in *Linnaea* **36**: 117 (1869), nom. illeg. (Art. 64.1), non (C. Presl) Kunze ex Mett. (1858), nec Kunze (1865). – *Lastrea sparsa* var. *nitidula* Beddome, *Suppl. ferns S. Ind.*: 17, pl. 374 (1876). – *Nephrodium sparsum* var. *nitidulum* (Beddome) C. B. Clarke in *Trans. Linn. Soc. Lond.* II (Bot.) **1**: 524 (1880). – *Dryopteris sparsa* subsp. *nitidula* (Beddome) C. Chr., *Index filic.*: 293 (1905). – *Dryopteris sparsa* var. *nitidula* (Beddome) Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 472 (1938). Type: Nepal, Arghoon [Nagarjum], 1821, *Wallich* 392 (K-W! – lectotype, selected here; BM!, E!, K! – isolectotypes).

Fronds small to medium-sized (up to *c.* 60 cm long). Stipe long, about the same length as the lamina, reddish-purple below, becoming reddish-stramineous above, ± thin, the base bearing scattered, small, thin, ovate, or ovate-lanceolate, mostly deciduous, mid- to somewhat dark brown scales, with dark fuscous-brown centres, scales ± absent on the top half of the stipe and on the rachis. Lamina becoming three times pinnate below, triangular-lanceolate, or ± deltate

(up to *c.* 20 cm wide), not narrowed at the base, bearing up to *c.* 15 pairs of usually somewhat distant pinnae; pinnae elongated triangular-lanceolate, usually somewhat abruptly tapering towards their apices, but sometimes extending into slightly caudate apices, slightly stiffly herbaceous, or very slightly crispaceous, smooth, pale- to mid-green, bearing a few scattered, small, narrow, pale brown scales on the costae and small glands on the lower surface, bearing up to *c.* 12 pairs of ± small pinnules; pinnules short, but usually longer than broad, ± contiguous, or slightly separate, triangular-lanceolate, stalked, but soon becoming narrowly attached to the pinna-costae, and then more widely attached further up the pinna, shallowly lobed (especially in sterile fronds which thus exhibit slight dimorphism), or the lower ones becoming deeply lobed in the lower pinnae, the lowest pinnules on the lowest pinnae often becoming pinnatisect in larger fronds, the lowest few pinnules on each pinna ± symmetrical, but the rest asymmetrical (except in sterile fronds where most of the segments may be ± symmetrical), with the lobes on their acroscopic side being more developed, longer and wider than the more obliquely sloping ones on the basiscopic side, and the basal acroscopic lobe (or both acroscopic and basiscopic ones in the lowest few pinnules) usually somewhat auriculate, pinnule-apices narrowing abruptly to an obtuse point, bearing a few, small, acute teeth (more prominent in sterile fronds), the basal pinnules on the basiscopic side of the lowest pair of pinnae somewhat developed and longer than those on the acroscopic side; pinnule-lobes or pinnulets ± rounded-rectangular, their apices ± obtusely pointed, bearing a few scattered, small, acute teeth around their margins and apices. Sori small, not, or only slightly crowded, in two rows, one on each side of the centre of the pinnule, close to the centre, indusiate; indusia somewhat small, slightly curved over the sorus, thin, lifting and shrivelling markedly and mostly deciduous. Spores regular.

Cytology: Diploid sexual (China (Szechuan): Wang & Zhang (1981), sub *D. sparsa* var. *nitidula*, voucher specimen, *Wang Z.-R. & Zhang, Z.-X.* c. 188 (PE!)).

Ecology: A species of the mid- and upper-level forest zone, growing on the ground among rocks, etc., from *c.* 1600–3600 m alt.

Range: India (central and eastern part of the W. Himalaya; E. Himalaya in Sikkim and ? N. Assam); Nepal; ? Bhutan; SE. Tibet; Burma; China (Yunnan, Szechuan, Kweichow, Kwangsi); Taiwan. A Sino-Himalayan species of the widespread sort, though local and uncommon.

Range in the Indian subcontinent: **32** Langera, Ravi valley, 6500 ft (1980 m), 1882, *J. C. McDonell* 43, 58 (K!, P!), and Chamba, 1 June 1887, *J. C. McDonell* (BM!, P!, RAW!); **58** 'Napalia', 1821, *Wallich* 392 (B!, BM!, K!, K-W!, P!, etc.), and Guheshwari, Kathmandu valley, 5000 ft (1520 m), 26 July 1958, *D. D. Bhatt* 265 (UC (M. 304221)!); **64** North slope of Sandukphoo, 11,000 ft (3340 m), October 1880, *H. C. Levinge* 58, and 13 October 1880 (K!); **65** Yakla, 10,000 ft (3040 m), 15 October 1869, *C. B. Clarke* 9813, 9845, 9870, 9876 A & B, 16 October 1869, *C. B. Clarke* 10020, 18 October 1869, *C. B. Clarke* 10088A, 2 October 1869, *C. B. Clarke* 10261 (BM!, E!, K!), and Tsomgo, 12,000 ft (3640 m), 6 August 1945, *N. L. Bor* 763 (BM!); **66** Yatung, 1897, *H. E. Hobson* (K!).

Notes: Dryopteris yoroii is reported under this name for the first time from the Indian subcontinent, though it has long been known there under the epithet *nitidula*, usually treated as a variety of *D. sparsa* (e.g. Ching, 1938), when not overlooked. Hope (1903: 743) recognised one of the above-cited McDonell specimens from Chamba as distinct, but was apparently unaware of Beddome's name *Lastrea sparsa* var. *nitidula*. Since the name *Dryopteris nitidula* (C. Presl) Kuntze has already been used for another species, it cannot be used here.

D. yoroii is clearly specifically distinct from *D. sparsa* and can be distinguished by its smaller fronds and shorter pinnules, the lowest ones being biauriculate, by the glands on the undersurface of the lamina, and by the reddish stipe and smaller, darker scales. It can resemble the south Indian and Sri Lankan *D. deparioides* subsp. *concinna*, particularly when sterile. The similar frond and segment shape of the W. Chinese species, *Cystopteris pellucida* (Franchet) Ching ex C. Chr. (holotype in P!), a less dissect relative of *C. sudetica* A. Braun & Milde, has also caused some confusion, though the frond of *D. yoroii* is much thicker and the indusia are different.

Clarke (1880) and Beddome (1896) report the species from Bhutan, possibly in error, as the author has seen no specimens, though it should occur there. Price (1977) tentatively reports it

Fig. 59 *Dryopteris yoroii.* India, Sikkim, Yakla, 15 October 1869, *C. B. Clarke* 9876 B (BM). Scale line = 1 cm.

from the Philippines under the name *D. sparsa* var. *nitidula*, on the basis of glandular plants, but the specimens cited have been re-identified by the present author as a mixture of *D. sparsa* (*Price* 813 and 1578), *D. cacaiana* (Price 1042), new to the Philippines, and *D. platypus* (Price 2398),

also new to the Philippines. The author is grateful to Dr M. G. Price for his permission to include these records.

54. Dryopteris deparioides (T. Moore) Kuntze

Revis. gen. pl. **2**: 812 (1891). – *Diclisodon deparioides* T. Moore, *Index fil.*: xcv–xcvi (April 1857). – *Aspidium deparioides* (T. Moore) Hook., *Fil. exot.*: pl. 3 (September 1857). – *Nephrodium deparioides* (T. Moore) Hook., *Fil. exot.*: pl. 53 text (1858). – *Lastrea deparioides* (T. Moore) Beddome, *Ferns S. India*: 36, pl. 104 (1863). Type: Sri Lanka, [*Thwaites*] C.P. 3062, Thomas Moore's herbarium (K! – lectotype, selected here).

This species is remarkably polymorphic and is divided here into four subspecies, two of which were until now treated as species, and the other two of which were recently reduced to subspecies by Sledge (1973), having been previously treated as species. These subspecies are distinct from each other, though some of them, notably subsp. *gracillima*, show variation which tends to indicate connection with some of the other subspecies. Another such case is subsp. *concinna*, the sterile fronds of which are almost identical to those of subsp. *deparioides*. The different subspecies also display some local geographical separation and do not normally occur together, appearing to constitute local topotypes. Further work is required to ascertain the relationships of the various taxa in this unusual and confusing complex species.

54a. Dryopteris deparioides subsp. **deparioides** **Fig. 60**

Fronds medium-sized (up to *c.* 80 cm long). Stipe long, the same length as, or longer than, the lamina, pale, slightly thin, the base bearing scattered, somewhat small, thin, ovate-lanceolate, pale- or frequently slightly russet-brown scales, occasionally with slightly darker central areas at their bases, scales ± absent from the top half of the stipe and from the rachis, rachis and costae bearing a very few scattered, very small glands on their upper surface. Lamina twice pinnate, widely lanceolate (up to *c.* 28 cm wide), slightly narrowed to a truncate base, bearing up to *c.* 17 pairs of ± distant pinnae; pinnae narrowly lanceolate or ± linear, with a somewhat abruptly tapering apex, stiffly herbaceous and somewhat crispaceous, smooth, pale- to mid-green above, ± glabrous, bearing up to *c.* 15 pairs of somewhat large pinnules; pinnules longer than broad, somewhat separate from each other, ovate-lanceolate, stalked at the bases of the pinnae, but soon becoming narrowly attached to the pinna-costae and more widely attached further up the pinna, unlobed (especially in sterile fronds), or ± shallowly lobed, becoming more deeply lobed in the lowest pinnules of fertile fronds, with rounded lobes, bearing a few scattered, small, narrowly acute teeth around the margins and apices, the teeth becoming large and prominent in fertile fronds, pinnules asymmetrical with decurrent basiscopic bases and somewhat extended, or slightly auriculate acroscopic ones, pinnule-apices ± obtusely pointed, basal basiscopic pinnules on the lower pinnae not becoming more developed than those on the acroscopic side. Fertile fronds bearing small, indusiate sori, singly, near the tips of the well-developed and slightly splayed-out pinnule-teeth; indusia slightly curved over the sorus, small, thin, lifting and shrivelling markedly and often splitting. Spores regular.

Cytology: Diploid sexual (Sri Lanka: Manton & Sledge (1954), voucher specimen, *W. A. Sledge* P.374, 1951 (BM!)).

Ecology: A plant of the lower-montane forest zone, growing on the ground below trees, from *c.* 300–900 m alt.

Range: India (south, rare); Sri Lanka. An endemic, probably to be considered of south-east Asian affinity.

Range in the Indian subcontinent: **94** Anamallay Hills, *R. H. Beddome* (K!); **95** Adam's Peak, Ratnapura side, 300–450 m, 5 January 1951, *I. Manton & W. A. Sledge* 826 (BM!, K!).

Notes: This subspecies is remarkable for the position of its sori which are nearly at the apices of the pinnule-teeth, a condition not known in any other species of *Dryopteris*. Though this feature is constant, it is perhaps correct to treat it as a somewhat abnormal state which has become fixed

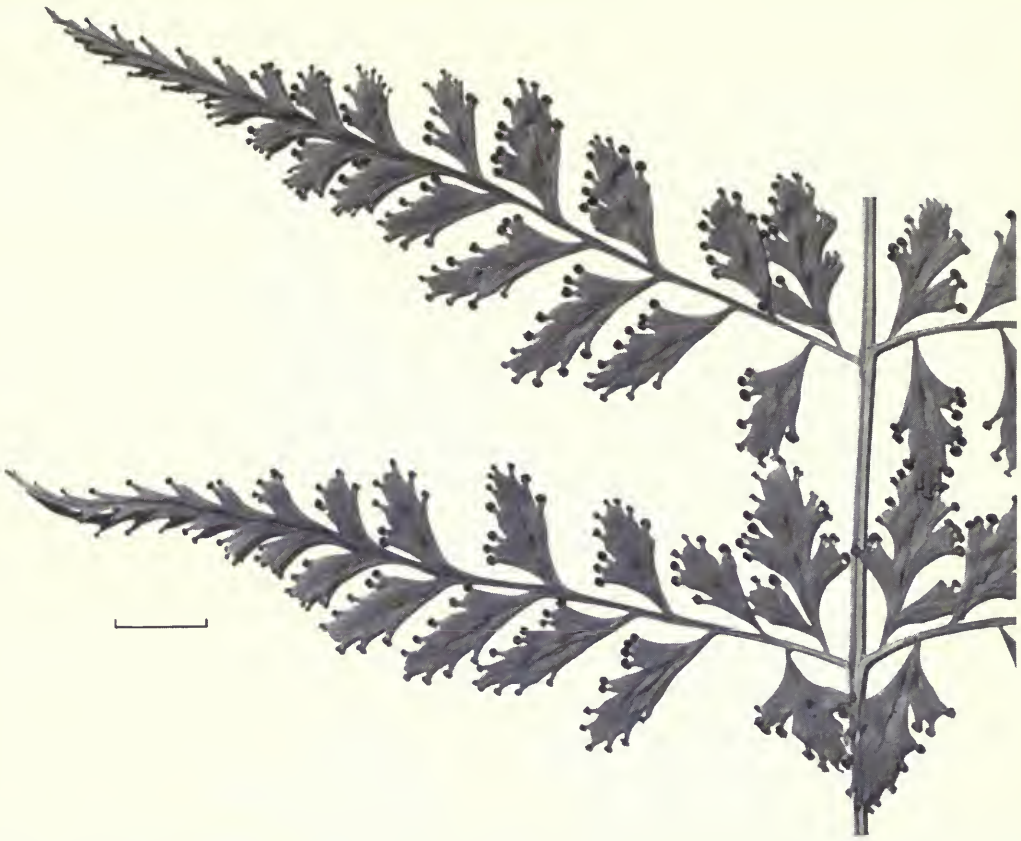

Fig. 60 *Dryopteris deparioides* subsp. *deparioides*. Sri Lanka, Adams Peak, 1951, *W. A. Sledge* P.374 (BM). Scale line = 1 cm.

in the population. It is otherwise identical to subsp. *concinna*. A few specimens of subsp. *gracillima* approach the same condition. Moore (1857) erroneously described a new monotypic genus, *Diclisodon*, on the basis of this characteristic, and in doing so, validated the single species he placed in it.

54b. Dryopteris deparioides subsp. **concinna** C. Chr. **Fig. 61**

Index filic. Suppl. tert.: 84 (1934). *Lastrea concinna* Beddome, *Ferns S. India*: 82, pl. 247 (September 1864), nom. illeg. (Art. 64.1), non (Willd.) T. Moore (1858). *Aspidium concinnum* Thwaites, *Enum. pl. zeyl.*: 392, 438 (December 1864), nom. illeg. (Art. 64.1), non Link (1833), nec Mett. (1856). Type: Sri Lanka, Sinha Raja forest, April 1863, *Thwaites* C.P. 3798 (K! – lectotype, selected here; B!, BM!, CGE!, K!, P!, PDA – isolectotypes).

Nephrodium thwaitesii Baker in Hook. & Baker, *Syn. fil.*: 277 (1867). – *Lastrea thwaitesii* (Baker) Beddome, *Suppl. ferns S. Ind.*: 18 (1876). – *Dryopteris thwaitesii* (Baker) Kuntze, *Revis. gen. pl.* **2**: 813 (1891), non (Hook.) C. Chr. (1905). Type: as for *Dryopteris deparioides* subsp. *concinna* C. Chr.

Dryopteris emigrans Copel. in *Univ. Calif. Publs Bot.* **12**: 392 (1931), nom. illeg. (Art. 63.1). Type: as for *Nephrodium thwaitesii* Baker.

Similar to subsp. *deparioides* in every way except that the sori are just within the margin of the pinnules at the bases of the teeth instead of outside it at the tips of the teeth.

Cytology: Unknown.

Range: Sri Lanka (rare). An endemic, probably of south-east Asian affinity.

Fig. 61 *Dryopteris deparioides* subsp. *concinna.* Sri Lanka, Deniyaya, above Beverley Estate, 12 March 1954, *W. A. Sledge* 1273 (BM). Scale line = 1 cm.

Range in the Indian subcontinent: **100** Sinha Raja forest above Beverley Estate, Deniyaya, 900 m, 12 March 1954, *W. A. Sledge* 1273 (BM!, K!).

Notes: Subsp. *concinna* appears to be a more normal form of the species than subsp. *deparioides*, as first suggested by Beddome, but the two are very close. It is treated here as a separate subspecies because of its local geographical separation (see Sledge, 1973).

54c. Dryopteris deparioides subsp. **ambigua** (Sledge) Fraser-Jenkins, **comb. nov.** **Fig. 62**

Dryopteris ambigua Sledge in *Bull. Br. Mus. nat. Hist.* (Bot.) **5** (1): 23, fig. 4 (1973). Type: Sri Lanka, *Thwaites* C.P. 1370 (K! – holotype; BM!, CGE!, E!, PDA – isotypes; specimens with the same number also in B!, P!).

Misapplied name: Lastrea sparsa var. *purpurascens* sensu Trimen (1885), non *Aspidium purpurascens* Blume (1828).

Differs from subsp. *concinna* in being slightly smaller and more delicate in all its parts. The stipe-base scales are usually smaller, the stipe, rachis, and pinna-costae are noticeably more glandular, with larger glands, the lamina is slightly more triangular-lanceolate and bears scattered glands, and the pinnules are more stalked at their bases and more pointed at their apices with slightly more acute lobes. The sori are close to the pinnule margins and the indusia are glandular.

Cytology: Unknown.

Range: Sri Lanka. An endemic, probably of south-east Asian affinity.

Range in the Indian subcontinent: **100** Tonacombe, Uva Province, 1320 m, 21 February 1954, *W. A. Sledge* 1164 (BM!, K!, US!).

Fig. 62 *Dryopteris deparioides* subsp. *ambigua*. Sri Lanka, Namunakula, above Tonacomb Estate, 21 February 1954, *W. A. Sledge* 1164 (BM). Scale line = 1 cm.

Notes: Subsp. *ambigua* was described as a species by Sledge (1973), but in its morphology it is extremely close to the other subspecies of *D. deparioides* and perhaps shows the closest similarities to subsp. *gracillima*. It appears to represent no more than another aspect of the polymorphy within *D. deparioides* and, like the other subspecies, is topographically separated. Hence it is given subspecific rank here. Cytological and other investigation is required to confirm its relationships, however, and it should be noted that Sledge reports a larger spore-size in the Tonacombe plant cited above.

54d. Dryopteris deparioides subsp. **gracillima** (Ching) Fraser-Jenkins, **comb.nov. Figs 63–65**

Dryopteris gracillima Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 452 (1938). – *Dryopteris gracillima* var. *gracillima* in Sledge, *Bull. Br. Mus. nat. Hist.* (Bot.) **5** (1): 19 (1973). Type: Sri Lanka, *Thwaites* C.P. 3383 (K! – lectotype, selected here; B!, BM!, CGE!, E!, P!, PDA! – isolectotypes).

Nephrodium sparsum var. *minus* Thwaites ex Baker in Hook. & Baker, *Syn. fil. ed.* **2**: 498 (1872). – *Lastrea sparsa* var. *minor* (Thwaites ex Baker) Beddome, *Suppl. ferns S. Ind.*: 17 (1876). Type: as for *Dryopteris gracillima*.

Dryopteris gracillima var. *prolongata* Sledge in *Bull. Br. Mus. nat. Hist.* (Bot.) **5** (1): 19, fig. 3A (1973). Type: Sri Lanka, rock crevices in jungle, Gallebodde Rock, Central Province, 27 January 1954, *W. A. Sledge* 1055 (BM! – holotype; K!, US! – isotypes).

Dryopteris gracillima var. *triangularis* Sledge in *Bull. Br. Mus. nat. Hist.* (Bot.) **5** (1): 19, fig. 3B (1973). Type: Sri Lanka, terrestrial in jungle on Knuckles Mt., Central Province, 1725 m, 30 January 1954, *W. A. Sledge* 1089 (BM! – holotype).

Fronds considerably smaller than in the other subspecies (up to *c.* 30 cm long), ± sparsely glandular, narrowly elongated triangular-lanceolate. Pinnae varying from merely lobed to pinnate; pinnules small, often bearing small, narrow, acutely pointed lobes, or obtuse ones. Most plants have ± attenuated frond apices.

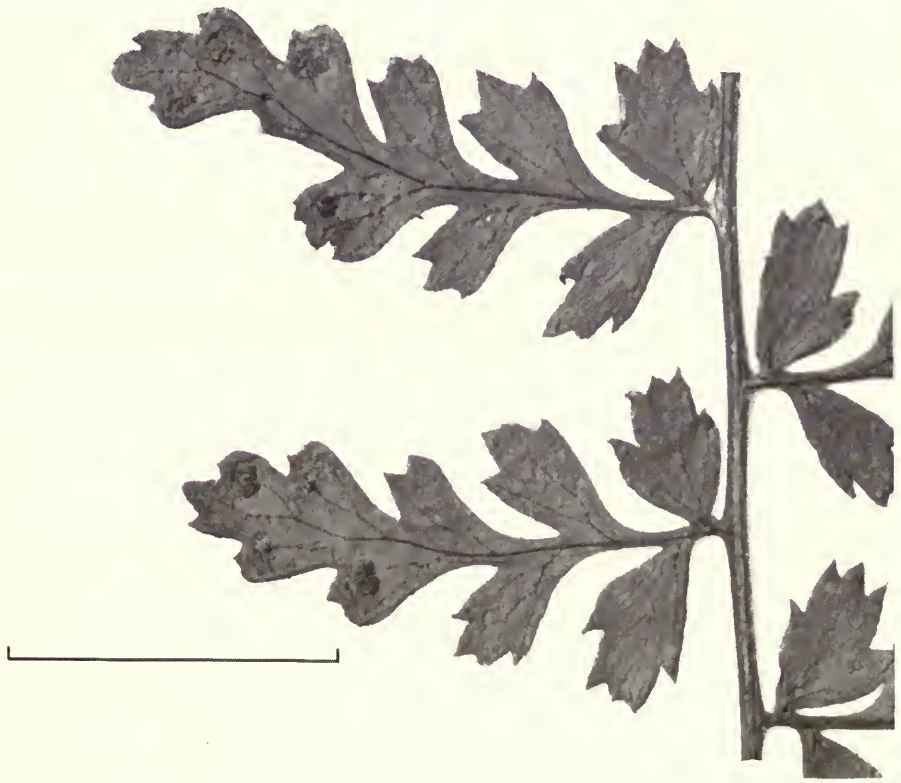

Fig. 63 *Dryopteris deparioides* subsp. *gracillima* (typical form). Sri Lanka, Central Province, *Thwaites* C.P. 3383 (K – lectotype). Scale line = 1 cm.

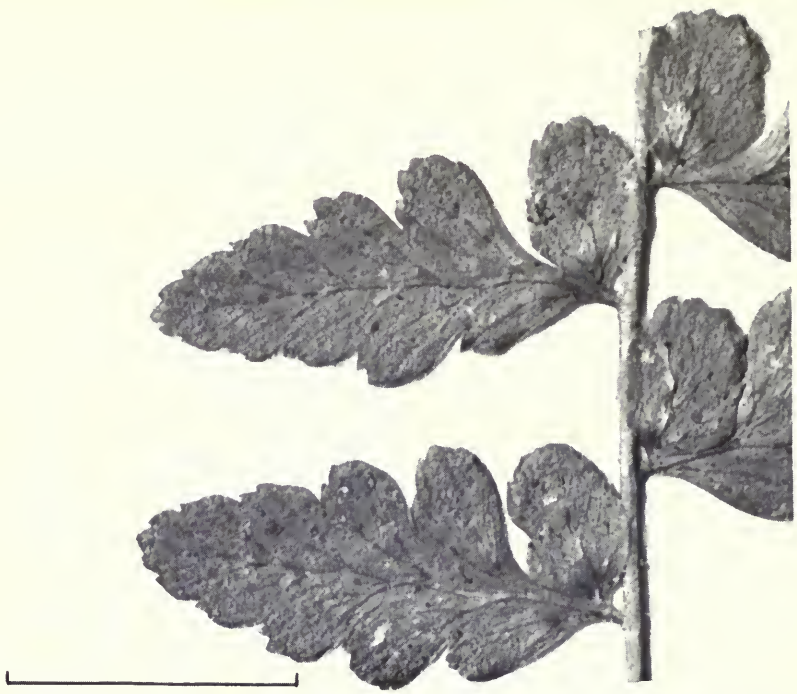

Fig. 64 *Dryopteris deparioides* subsp. *gracillima* ('*prolongata*' form). Sri Lanka, Central Province, Ambagamuwa District, Midford, 29 January 1954, *W. A. Sledge* 1066 (BM). Scale line = 1 cm.

Cytology: Diploid sexual (Sri Lanka: Manton & Sledge (1954), voucher specimen, *W. A. Sledge* P.58, 1951 (BM!)).

Ecology: As for subsp. *deparioides*, but growing at somewhat higher altitudes, from *c.* 1300–1700 m alt.

Range: Sri Lanka. An endemic, probably of south-east Asian affinity.

Range in the Indian subcontinent: **100** Rock face in secondary jungle, Corbet's Gap, 1350 m, 9 December 1950, *W. A. Sledge* 566 (BM!).

Notes: This taxon is sufficiently distinct to constitute a subspecies, though in some respects it appears to be a precociously fertile state of the species, the condition having become fixed in the populations. It is undoubtedly significant that populations occur which are intermediate between subsp. *gracillima* and subsp. *ambigua*, or between it and subsp. *concinna*. These have been named as var. *triangularis* Sledge. It is also interesting that the soral position varies from marginal to (rarely) just below the apices of the pinnule-teeth, as in subsp. *deparioides*. Sledge (1973) also mentions an example with the sori on columns of tissue as in *Peranema cyatheoides* D. Don.

Subsp. *gracillima* has been erroneously reported as collected by Edgeworth from Simla, N. India, by Beddome (1876) and Clarke (1880) (see Sledge, 1973: 23). The original specimen (K!) is this taxon, but is mounted on a sheet with several other specimens. It is clear that the labels have been written in the wrong place on the sheet as several fronds of *Athyrium anisopterum* Christ on the same sheet and matching the Himalayan material of that species are labelled as being from Ceylon, collected by Mrs Walker in 1880. However, the Himalayan and Chinese species, *A. anisopterum*, does not occur in Sri Lanka or S. India, despite the reports of Sledge (1962, 1973, 1982), who has erroneously used the name for smaller and less dissect plants of *A. puncticaule* (Blume) T. Moore. On cytological and morphological grounds it is possible that the

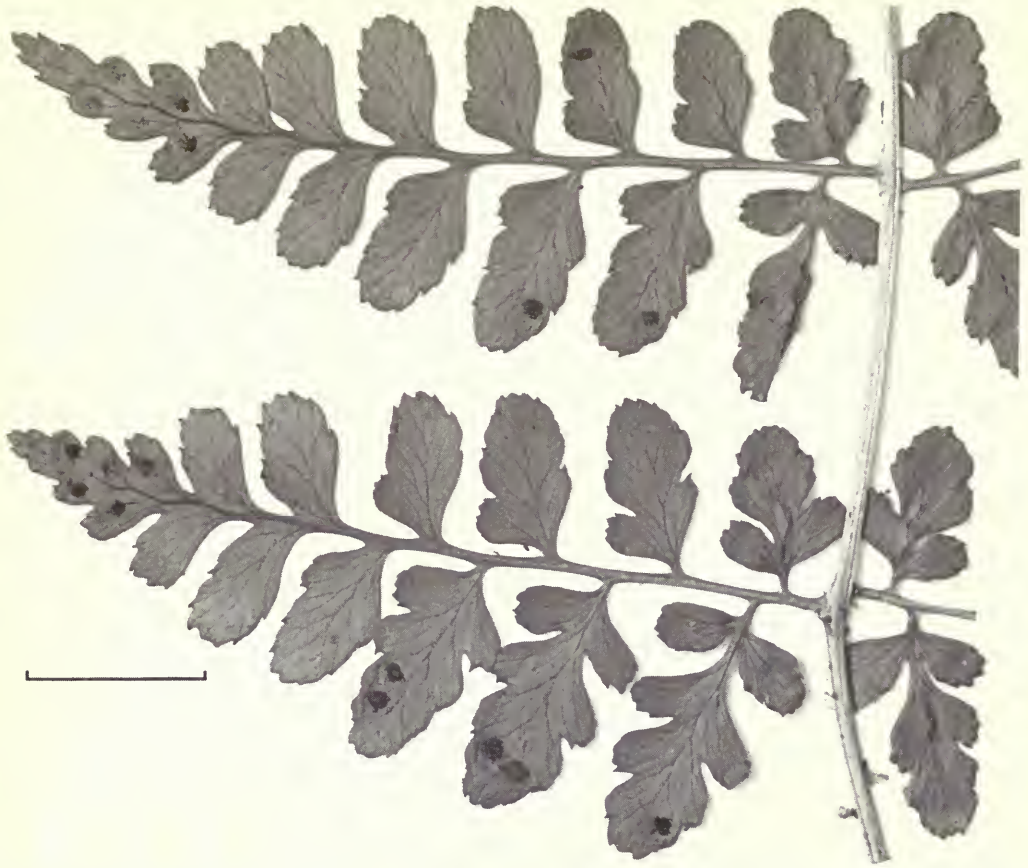

Fig. 65 *Dryopteris deparioides* subsp. ?*gracillima* ('*triangularis*' form). Sri Lanka, Central Province, Knuckles Mt, 30 January 1954, *W. A. Sledge* 1089 (BM – holotype of *Dryopteris gracillima* var. *triangularis* Sledge). Scale line = 1 cm.

small plants from S. India represent a distinct taxon within the aggregate of *A. puncticaule*, different from *A. anisopterum*.

55. Dryopteris sri-lankensis Fraser-Jenkins, **nom. nov.** **Fig. 66**

Lastrea deltoidea Beddome, *Ferns S. India*: 83, pl. 248 (1864), nom. illeg. (Art. 64.1), non (Sw.) T. Moore (1858), nec *Dryopteris deltoidea* (Sw.) Kuntze (1891). – *Lastrea sparsa* var. *deltoidea* Beddome, *Handb. ferns Brit. India*: 254 (1883), nom. illeg. (Art. 63.1). Type: Sri Lanka, 'Thw. En. 1368' (BM! – lectotype, selected here).

Aspidium sparsum var. *frondium* Thwaites, *Enum. pl. zeyl.*: 392 (1864). Type: Sri Lanka, *Thwaites* C.P. 1368 (PDA! – lectotype, selected here; BM! – isolectotype).

Dryopteris simulans Ching in *Bull. Fan meml Inst. Biol.* (Bot.) **8**: 473 (1938), nom. illeg. (Art. 64.1), non (Baker) Kuntze (1891). Type: as for *Lastrea deltoidea* Beddome.

Fronds medium-sized to large (up to *c.* 110 cm long). Stipe long, as long as, or longer than, the lamina, pale or stramineous, the base bearing a few small, scattered, thin, pale brown, lanceolate scales, which are absent above the stipe-base and from the rachis, except for a few very small, scattered, narrow ones, ± in loose tufts at the junctions of the rachis with the pinna-costae. Lamina twice pinnate, a third time deeply pinnatifid, markedly widely triangular-lanceolate or deltate (up to *c.* 40 cm wide), widest at the base, bearing up to *c.* 18 pairs of distant pinnae, at least the lower ones opposite, and all except the upper ones not sloping; pinnae narrowly linear-lanceolate, herbaceous, smooth, pale- to mid-green above, bearing a few small,

Fig. 66 *Dryopteris sri-lankensis*. Sri Lanka, Gallebodde, 26 January 1954, *W. A. Sledge* 1044 (BM). Scale line = 1 cm.

scattered, narrow, pale brown scales at the base of the pinna-costae near their point of attachment to the rachis, bearing up to *c.* 19 pairs of medium-sized pinnules; pinnules ± short, but longer than broad, usually ± well separated from each other, ovate-lanceolate, or somewhat triangular-lanceolate, stalked, or becoming narrowly attached to the pinna-costa further up the pinna, very closely juxtaposed to the pinna-costa and those at the base of each pinna opposite each other and very close to the rachis, often overlapping it, pinnules deeply lobed but becoming shallowly lobed in the upper pinnules, pinnule-lobes crowded, rounded-rectangular, with rounded apices, and usually bearing a sharp tooth at their acroscopic corners, pinnules slightly asymmetrical, the lobes on the acroscopic side being larger than the more obliquely sloping ones on the basiscopic side, pinnule-apices obtusely pointed, the lowest basiscopic pinnules on the lower pinnae slightly shorter than those on the acroscopic side, and the lowest basiscopic pinnule often markedly shorter than the lowest acroscopic one. Sori small, not crowded, in two rows, one on each side of the centre of the pinnule near the pinnule-margin, though the lower lobes of lower pinnules may themselves bear two short rows of sori, indusiate; indusia ± flat, or slightly curved over the sorus, thin, lifting and shrivelling markedly and mostly deciduous. Spores regular.

Cytology: Unknown.

Ecology: A species of the lower mid-level forest zone, growing on the ground below trees, from *c.* 600–1400 m alt.

Range: Sri Lanka. An endemic species, probably of south-east Asian affinity.

Range in the Indian subcontinent: **100** Gallebodde, 1050 m, 26 January 1954, *W. A. Sledge* 1044 (BM!).

Notes: A new name is necessary as *Dryopteris simulans* had already been used for another species when Ching (1938) applied it to the present plant.

56. Dryopteris macrochlamys (Fée) Fraser-Jenkins, **comb. nov.** **Figs 67–69**

Aspidium macrochlamys Fée, *Mém. foug.* **5**: 295 (1852). Type: Sri Lanka, *Gen. Walker*, Herb. Hooker (K! – lectotype, selected here).

Lastrea undulata Beddome, *Ferns S. India*: 88, pl. 271 (September 1864). – *Nephrodium undulatum* (Beddome) Baker in Hook. & Baker, *Syn. fil.*: 276 (1867). – *Lastrea sparsa* var. *undulata* (Beddome) Beddome, *Handb. ferns Brit. India*: 254 (1883). – *Dryopteris undulata* (Beddome) Kuntze, *Revis. gen. pl.* **2**: 814 (1891). – *Acrorumohra undulata* (Beddome) Ching in *Acta phytotax. sin.* **9** (4): 385 (1964). *Aspidium undulatum* Thwaites, *Enum. pl. zeyl.*: 444 (December 1864), nom. illeg. (Art. 64.1), non Afzel. ex Sw. (1801). Type: Sri Lanka, Wattakelly Hill, Kallibokha, 5000 ft, September 1864, [*W. N. Beckett*, comm. *Thwaites* C.P. 3858], Herb. Beddome (K! – lectotype, selected here; B!, BM!, CGE!, E!, K!, P!, PDA – isolectotypes).

Aspidium obtusissimum Mett. ex Kuhn in *Linnaea* **36**: 119 (1869). – *Lastrea sparsa* var. *obtusissima* (Mett. ex Kuhn) Beddome, *Suppl. ferns S. Ind.*: 17, pl. 375 (1876). – *Dryopteris obtusissima* (Mett. ex Kuhn) Christ in *J. Bot. Paris* II, **1**: 231 (1908). – *Rumohra obtusissima* (Mett. ex Kuhn) Ching in *Sinensia, Shanghai* **5**: 62 (1934). – *Arachniodes obtusissima* (Mett. ex Kuhn) Ching in *Acta bot. sin.* **10**: 259 (1962). – *Acrorumohra obtusissima* (Mett. ex Kuhn) Ching in *Acta phytotax. sin.* **9** (4): 385 (1964). Type: Sri Lanka, *Thwaites* C.P. 1369 (B! – lectotype, selected here; B!, BM!, CGE!, E!, K!, P!, PDA – isolectotypes).

Rumohra zeylanica Ching in *Sinensia, Shanghai* **5**: 70 (1934), nom. illeg. (Art. 63.1). – *Arachniodes zeylanica* (Ching) Ching in *Acta bot. sin.* **10**: 260 (1962), nom. illeg. (Art. 63.1). Type: as for *Lastrea undulata* Beddome.

Fronds medium-sized or large (up to *c.* 100 cm long). Stipe long, as long as the lamina, brownish at the base and mid-green above, slightly thick, the base bearing scattered, thin, russet-brown, lanceolate scales, which become smaller and more scattered further up the stipe, and nearly absent from the top of the stipe and the rachis, apart from a few small, narrow scales about the points of attachment of the pinna-costae to the rachis, rachis bearing a few very scattered, very small glands on the top surface. Lamina markedly dimorphic, but with some intermediate states occurring, the two types of frond even occurring in the same plant, the extremes being as follows: 1. *The non-flexuose lamina type.* Rachis straight. Lamina twice pinnate, triangular-lanceolate (up to *c.* 30 cm wide), not narrowed to the base, bearing rather few (up to *c.* 10 pairs) distant pinnae; pinnae inserted at right angles to the rachis, or slightly obliquely sloping, linear-lanceolate, ± stiffly herbaceous, smooth, pale- to mid-green above, glabrous apart from a few very scattered, very small glands on the top surface of the costae, bearing up to *c.* 10 pairs of large pinnules; pinnules separate from each other, ovate-lanceolate, stalked at their bases at the bases of the pinnae, but soon becoming narrowly attached to the costae further up the pinna and widely attached beyond half-way up the pinna, deeply lobed or pinnatifid in the lowest pinnules, but shallowly lobed elsewhere, or more or less unlobed in the upper ones, pinnule-lobes large, markedly obtusely rounded, bearing a few small, wide-based, acute teeth, or none at all, pinnules slightly asymmetrical, the lobes on the acroscopic side being slightly larger than those on the basiscopic side, and the basiscopic base of the pinnule being decurrent to the pinna-costa, the acroscopic side slightly auriculate, pinnule-apices obtusely or somewhat acutely pointed, but usually with a blunt apical point, bearing a few small, wide-based, acute teeth, pinnules on the basiscopic side of the lowest pair of pinnae somewhat developed and longer than those on the acroscopic side. 2. *The flexuose lamina type.* Rachis markedly bent into a zig-zag pattern, the bends occurring abruptly at each junction of a pinna-costa with the rachis. Lamina three times pinnate, often becoming a fourth time pinnatifid towards the base, or occasionally a fourth time

Fig. 67 *Dryopteris macrochlamys* (non-flexuose form). Sri Lanka, Adams Peak, 1951, *W. A. Sledge* Z.3 (BM). Scale line = 1 cm.

Fig. 68 *Dryopteris macrochlamys* (semi-flexuose form). Sri Lanka, *Thwaites* C.P. 1369 (BM). Scale line = 1 cm.

Fig. 69 *Dryopteris macrochlamys* (flexuose form). Sri Lanka, *Beddome* (BM). Scale line = 1 cm.

pinnate below in larger fronds, elongated triangular-lanceolate (up to *c.* 25 cm wide), not narrowed to the base, bearing up to *c.* 12 pairs of crowded or overlapping pinnae; pinnae slightly or markedly backward-deflexed from the point of attachment to the rachis, elongated triangular-lanceolate, more or less stiffly herbaceous, smooth, pale- to mid-green above, glabrous apart from a few, very scattered, very small glands on the top surface of the costae, bearing up to *c.* 12 pairs of large pinnules; pinnules somewhat long, more or less backward-deflexed from their point of attachment, crowded, narrowly triangular-lanceolate, stalked, pinnate (occasionally merely very deeply pinnatifid), slightly asymmetrical, the pinnulets on their acroscopic side being slightly longer than those on their basiscopic side, pinnule-apices obtuse or somewhat narrowly rounded, bearing more or less small, wide-based teeth, pinnules on the basiscopic side of the lowest pairs of pinnae developed and longer than those on the acroscopic side, the basal basiscopic ones being the longest; pinnulets crowded, small, stalked at the base of the pinnules but rapidly becoming narrowly attached further up, ± ovate-lanceolate or rounded, the lowest ones in large fronds becoming pinnatifidly lobed with small, rounded lobes, or rarely, even a fourth time pinnatisect in large fronds, slightly asymmetrical, decurrent at their basiscopic bases and slightly developed at their acroscopic bases, bearing ± small, wide-based teeth at their apices and at the apices of their lobes. *Both lamina types.* Sori ± small, not crowded, in two short rows, one on each side of the centre of the segment, nearer the margin than the centre, indusiate; indusia slightly curved over the sorus, thin, bearing very small glands or papillae, lifting and shrivelling markedly and mostly deciduous. Spores regular.

Cytology: Diploid sexual (Sri Lanka: Manton & Sledge (1954), sub *D. obtusissima*, voucher specimens (non-flexuose lamina type), *W. A. Sledge* P.252 and Z.3, 1951, (BM!)).

Ecology: A species of the mid-level forest zone, growing on the ground below trees, from *c.* 1500–2300 m alt.

Range: Sri Lanka. An endemic, probably of south-east Asian affinity.

Range in the Indian subcontinent: **100** Namunakula, 1920 m, 24 February 1954, *W. A. Sledge* 1186 (BM!) – non-flexuose lamina type; 'Ceylon', *G. Wall* (BM!, E!) – flexuose lamina type.

Notes: The remarkable occurrence of two frond types in *Dryopteris macrochlamys*, which is more markedly dimorphic than any other *Dryopteris*, has caused some confusion in the past, especially when authors have not been familiar with the species in the field. Some clear comments on this were given by Sledge (1973), who pointed out that Ching's separation of the flexuose and non-flexuose fronds into two distinct species is erroneous. It also seems to be incorrect to consider the flexuose lamina type as a monstrosity rather than a normal state (along with the non-flexuose type), not only from its frequency and the fact that both types may occur on the same plant (Wall, 1873; Sledge, 1973), but also because of the existence of two related species, *D. diffracta* and *D. subreflexipinna* Ogata, which only have a flexuose lamina type. However, there is at present no clear evidence to resolve the problem. Sledge (1973) has suggested that the two types (with some intermediates) could merely be caused by a viral infection, with different degrees of pathogenicity.

Ching (1934) gave this species the new name *Rumohra zeylanica*, having been confused by the anadromic arrangement of the pinnules and pinnulets, to which feature he attached too much importance as a rigid characteristic for separating *Dryopteris* and what is now called *Arachniodes*, ignoring the obvious relationship of the species to the *Dryopteris sparsa* group. Sledge (1973) used the name *D. obtusissima* for the species, instead of *D. undulata*, as he considered the latter to be based on a monstrosity and therefore to be rejected (Art. 71 of the International Code of Botanical Nomenclature has since been deleted).

The basionym of the present name for this species was stated by Christensen (1905) to be a synonym of *Dryopteris sparsa*, but he also included *Aspidium obtusissimum* within *D. sparsa*, and did not separate the two species. There are no specimens of *D. sparsa* from Sri Lanka collected by Walker (the collector of the type of *D. macrochlamys*) but there are three specimens of the present species, collected by General or Mrs Walker and preserved at K (!), where other Fée types frequently exist. More importantly, there are two more specimens of the present species at K (!), labelled as C.P. 1369 and bearing the name *Aspidium macrochlamys* Fée. One of these is labelled 'A. macrochlamys Fée, teste Moore'. The present species complies well with Fée's description and, therefore, the name is lectotypified here in this sense and becomes the legitimate name for the species.

57. **Dryopteris diffracta** (Baker) C. Chr. **Fig. 70**

Index filic.: 262 (1905). – *Nephrodium diffractum* Baker in *Bull. misc. Inf. R. bot. Gdns, Kew* 1898: 230 (1898). – *Aspidium diffractum* (Baker) Christ in *Bull. Herb. Boissier* **7**: 17 (1899). – *Rumohra diffracta* (Baker) Ching in *Sinensia, Shanghai* **5**: 69 (1934). – *Polystichum diffractum* (Baker) Masam., *Short fl. Formosa*: 26 (1936). – *Acrorumohra diffracta* (Baker) H. Itô in Nakai & Honda, *Nov. fl. jap.* **4**: 101 (1939 ['1938']). Type: China, Mengtze, S.E. mt. woods, 8000 ft, *A. Henry* 9028 (K! – holotype).

Dryopteris reflexipinna Hayata, *Icon. pl. formos.* **4**: 174, fig. 113 (1914). Type: Taiwan, Mt Arisan, Heishana, 7000 ft, March 1914, *B. Hayata & Takeo* Itô (TI – lectotype, selected here, only photograph seen).

Fronds medium-sized (up to *c.* 70 cm long). Stipe long, as long as, or longer than, the lamina, pale-stramineous or somewhat reddish, of medium thickness, the base bearing a few, ± scattered, thin, mid-brown, lanceolate scales; scales absent further up the stipe and on the rachis, rachis markedly bent into a zig-zag pattern, the bends occurring abruptly at each junction of a pinna-costa with the rachis. Lamina four times pinnate, often becoming a fifth time pinnatifid below, and occasionally a fifth time pinnate in large fronds, elongated triangular-lanceolate or ± deltate (up to *c.* 30 cm wide), not narrowed to the base, bearing up to *c.* 12 pairs of overlapping pinnae with somewhat long stalks, markedly backward-deflexed from the points of attachment to the rachis, triangular-lanceolate or triangular, somewhat lax-herbaceous, smooth, pale- to mid-green above, glabrous, bearing up to *c.* 10 pairs of large pinnules; pinnules long, backward-deflexed, usually overlapping, narrowly triangular-lanceolate, the basiscopic ones in lower pinnae markedly developed and longer than the acroscopic ones, the basal

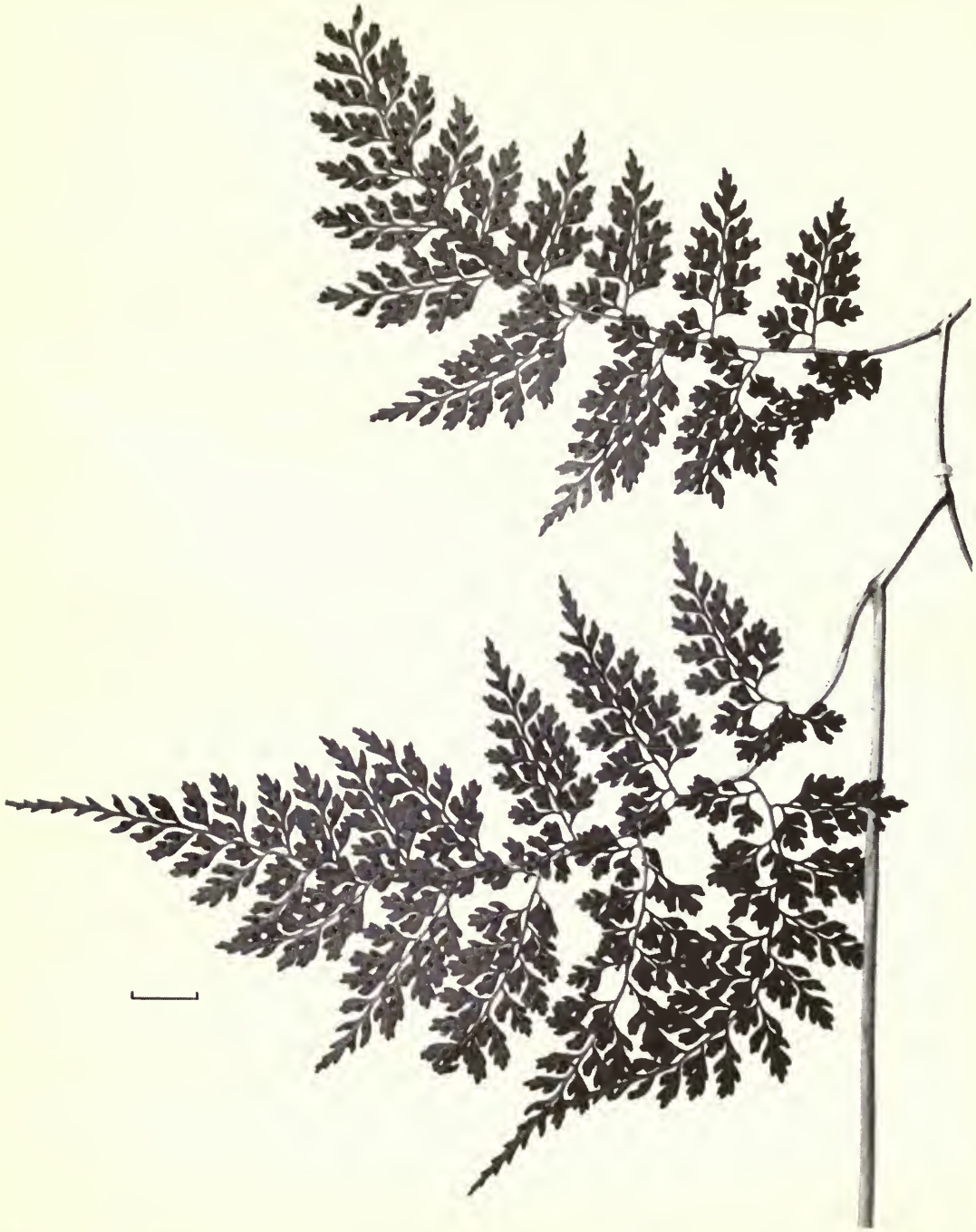

Fig. 70 *Dryopteris diffracta.* Taiwan, Mt Howuo, 25 December 1933, *M. Ogata* 267 (BM). Scale line = 1 cm.

basiscopic pinnules being the longest, pinnate, bearing up to *c.* 10 pairs of pinnulets; pinnulets usually ± contiguous, elongated triangular-lanceolate, pinnate, bearing up to *c.* 6 pairs of pinnulet-segments; pinnulet-segments (fourth-order segments) stalked, distant from each other, slightly asymmetrical, their basiscopic side being decurrent to the axis and their acroscopic side slightly longer and more developed, segment apices obtuse or somewhat narrowly rounded, bearing small, wide-based, acute teeth, the lowermost segments deeply lobed or sometimes pinnatisect, with rounded, ± distant lobes or segments, which bear a few small, wide-based, acute teeth around their apices. Sori small, not crowded, in two short rows, one on each side of the segment centre, midway between the centre and the margins, indusiate; indusia flat, or slightly curved over the sorus, thin, lifting and shrivelling markedly, mostly deciduous. Spores regular.

Cytology: Tetraploid (Taiwan: Tsai (1973). Tsai & Shieh (1975)).

Ecology: A species of the lower mid-level forest zone, growing on the ground below trees, from *c.* 1300–2200 m alt.

Range: India (Assam, rare); Burma; SE. Tibet; China (Yunnan, Kweichow, Kwangsi, Hainan); Taiwan; N. Vietnam. A south-east Asian element.

Range in the Indian subcontinent: **75** Duphla Hills, 7000 ft (2130 m), 1874, *Col. Baigree* (CAL!).

Notes: An overlooked species in the Indian subcontinent, reported here for the first time and known only from the collection cited above, misidentified until now. *Dryopteris diffracta* is the type species of Itô's genus *Acrorumohra*, now sunk into *Dryopteris* (Fraser-Jenkins, 1986).

Hybrids

The term hybrid as used here refers to the direct F_1 result, arising de novo from an act of hybridisation between two species and to the infrequent F_2 individuals which may occasionally be formed in nature (in low numbers) if the hybrid is a more or less sterile apomictic one. It excludes apomictic and allopolyploid species, which for the most part were originally derived from hybrids but are highly fertile and form widespread populations, behaving in every respect as other species do, reproducing and maintaining themselves.

Before the present study only one *Dryopteris* hybrid was known from the Indian subcontinent, the triploid *D. sparsa* hybrid reported by Mehra & Loyal (1965), and they were thought to be more or less absent from the area (Mehra & Loyal, 1965; Loyal, 1981). However, as with other areas, once the species themselves are more clearly known the presence of hybrids (confirmable by their abortive spores) becomes more obvious. So far, nine hybrids have been found. It may be true to a certain extent that *Dryopteris* hybrids are infrequent in the Himalaya, but this is certainly due to the presence of a large number of apomictic species which cannot hybridise together but only with sexual species, and to the general absence of allotetraploid species occurring sympatrically with their diploid ancestors (in such cases triploid back-cross hybrids are fairly frequent), rather than to reasons of stability of the flora; indeed, instability of the flora is the inference most clearly drawn from a study of *Dryopteris*. Non back-cross hybrids appear to occur with the same low level of frequency in the Himalaya as elsewhere.

1. Dryopteris × flemingii Fraser-Jenkins, **hybr. nov.** **Fig. 71**
(= *D. chrysocoma* × *D. juxtaposita*)

Planta *D. sublacerae* similis, sed frondibus maioribus, stipite plus minusve dense paleis nigris vestito, differt. Sporae abortivae. Cytotypus tetraploideus. Type: NW. India, Himachal Pradesh, between Simla and Narkanda, 3 km east of Matiana, 2400 m, 6 September 1977, *C. R. Fraser-Jenkins* 6968 (BM! – holotype). Merotypes (specimens grown from the type plant): *C. R. Fraser-Jenkins* 9419, ex hort. Chelsea Physic Garden, London, May 1979 (BM!) and 10430, ex hort. Chelsea Physic Garden, July 1981 (G!).

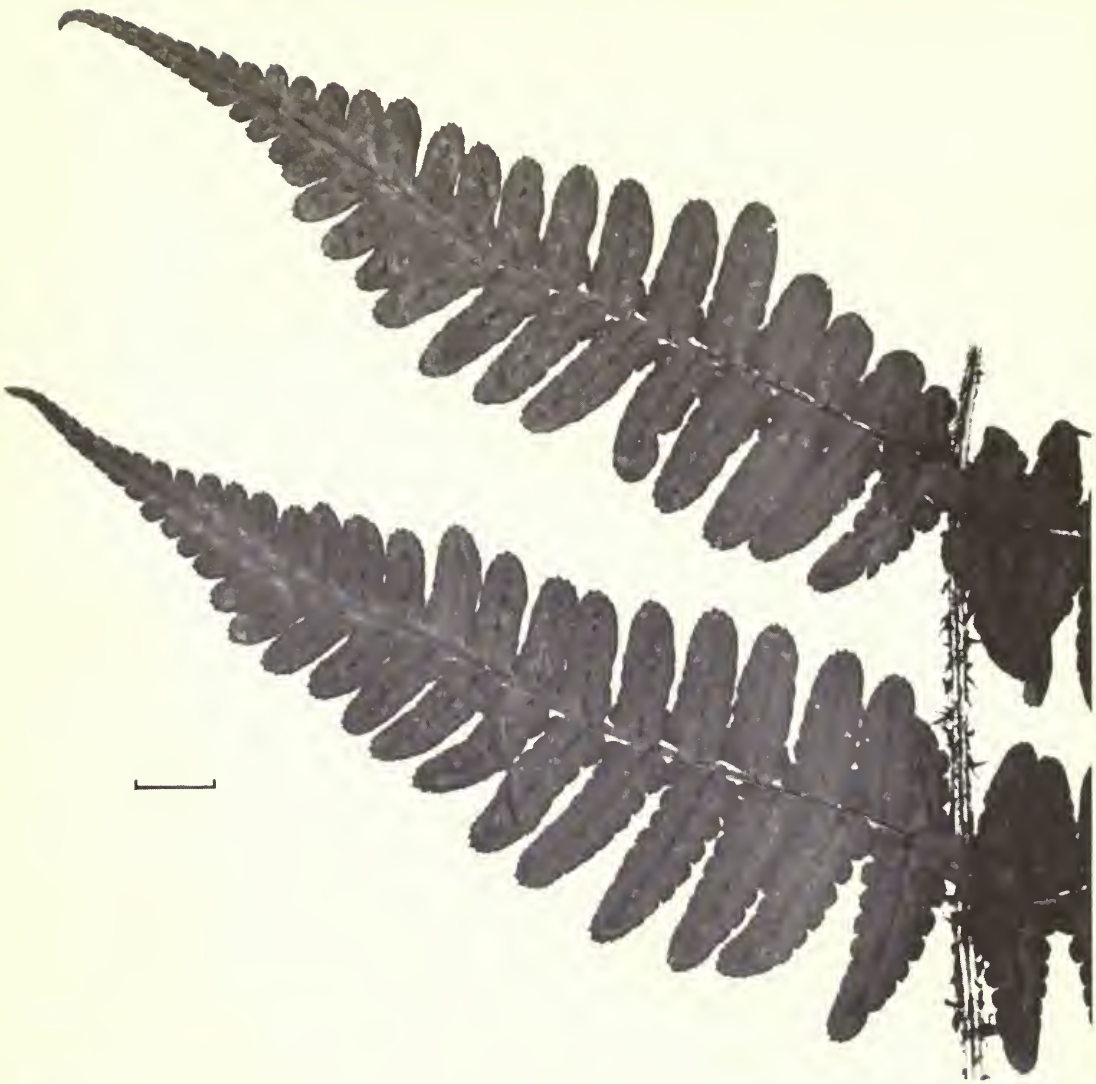

Fig. 71 *Dryopteris* × *flemingii* (= *D. chrysocoma* × *D. juxtaposita*). Ex hort. Chelsea Physic Garden, London, July 1981, *C. R. Fraser-Jenkins* 10430 (G – merotype). Scale line = 1 cm.

Similar to *Dryopteris sublacera*, but differing in having a larger, more developed frond and the stipe somewhat densely clothed, especially near the base, with ± wide, glossy, black scales, with slightly paler edges; and pinnules which are wider and more lobed. Sori large, indusia not markedly curved down and inflected at the edges at maturity. Spores abortive, though there appear to be a very few somewhat large spores which could perhaps be fertile.

Cytology: Tetraploid (Gibby, 1985).

Range: N. India.

Range in the Indian subcontinent: **37** As above.

Notes: Known only from the single specimen detailed above, but could occur elsewhere in the Himalaya. As well as the presumed parental species, the following were growing in the vicinity:

Dryopteris nigropaleacea, D. sublacera, and *D. stewartii*. It is therefore possible, as it is on cytological and gross-morphological grounds, that the parentage could be *D. nigropaleacea* × *D. sublacera*, which should also produce a tetraploid plant, though probably with more lobed pinnules than in the present plant, and more pinnate teeth.

This hybrid is named after the late Dr Robert L. Fleming Sr, formerly of Kathmandu and Mussoorie (see Fraser-Jenkins, 1984).

2. Dryopteris × ghatakii Fraser-Jenkins, **hybr. nov.** **Fig. 72**
(= *D. austro-indica* × *D. cochleata*)

Planta in morphologia inter *D. austro-indicam* et *D. cochleatam* intermedia. Stipes quam ille *D. cochleatae* brevior, plures paleas ferens. Lamina quam ille *D. cochleatae* basi angustiora. Frondes fertiles non contractae. Sori grandes. Sporae abortivae. Type: India, Madras [= Tamil Nadu], Salem District, Shevaroy Hills, the steep face of the hill flanking Archidia Estate, near Kakasholai, in open sun, 1580 m, 1 September 1964, *J. Ghatak* G730 (K! – holotype; CAL! – isotype).

Intermediate in morphology between *Dryopteris austro-indica* and *D. cochleata*. Stipe shorter than in *D. cochleata*, with more scales, including some narrow ones near the top; frond smaller and narrower at the base, with some small scales at the points of attachment of the pinna-costae to the rachis; pinnules shorter; and fertile fronds not contracted. Sori large, with markedly tall indusia which are curved down and inflected at the margins. Spores abortive.

Cytology: Unknown.

Range: S. India.

Range in the Indian subcontinent: **98** As above, and Kakasholai Hills, Yercaud, 1800 m, 20 January 1958, *K. Subramanyan* 7571 (CAL!, MH!).

Notes: Known only from the two collections cited. No *Dryopteris* species other than the parents are present in or near the Shevaroy Hills.

This hybrid is named after Dr J. Ghatak of Jawarharlal Nehru University, Imphal, who has produced valuable cytological records of Indian ferns.

3. Dryopteris × liddarensis Fraser-Jenkins, **hybr. nov.** **Fig. 73**
(= *D. barbigera* subsp. *barbigera* × *D. serrato-dentata*)

Planta in morphologia inter *D. barbigeram* et *D. serrato-dentatam* intermedia; *D. serrato-dentatae* similis, sed stipite paleis densiore vestito. Pinnae lobis quam illis *D. barbigerae* rectangularioribus, sed dentes longos similiter ferenti. Sporae abortivae. Type: NW. India, Kashmir, Liddar valley, north-east of Pahlgam, near Bajipath, east side of upper Chatponsal Nullah, 3400 m, in crevice of a non-calcareous, west-facing cliff, 21 August 1978, *C. R. Fraser-Jenkins* 7519 (BM! – holotype).

Intermediate in morphology between the parents though more similar in size to *D. serrato-dentata*, probably due to immaturity or adverse growing conditions. Stipe thin, more densely clothed in scales than in *D. serrato-dentata* but less densely than in *D. barbigera*. Pinnae short and pinna-lobes more rectangular than in *D. barbigera*, but bearing long teeth, similar to those in *D. barbigera*. Spores abortive.

Cytology: Unknown.

Range: N. India.

Range in the Indian subcontinent: **21** As above.

Notes: Known only from a single collection, but could occur elsewhere. As well as the parental species, the following were growing in the vicinity: *Dryopteris blanfordii* subsp. *blanfordii* and *D. pulcherrima*.

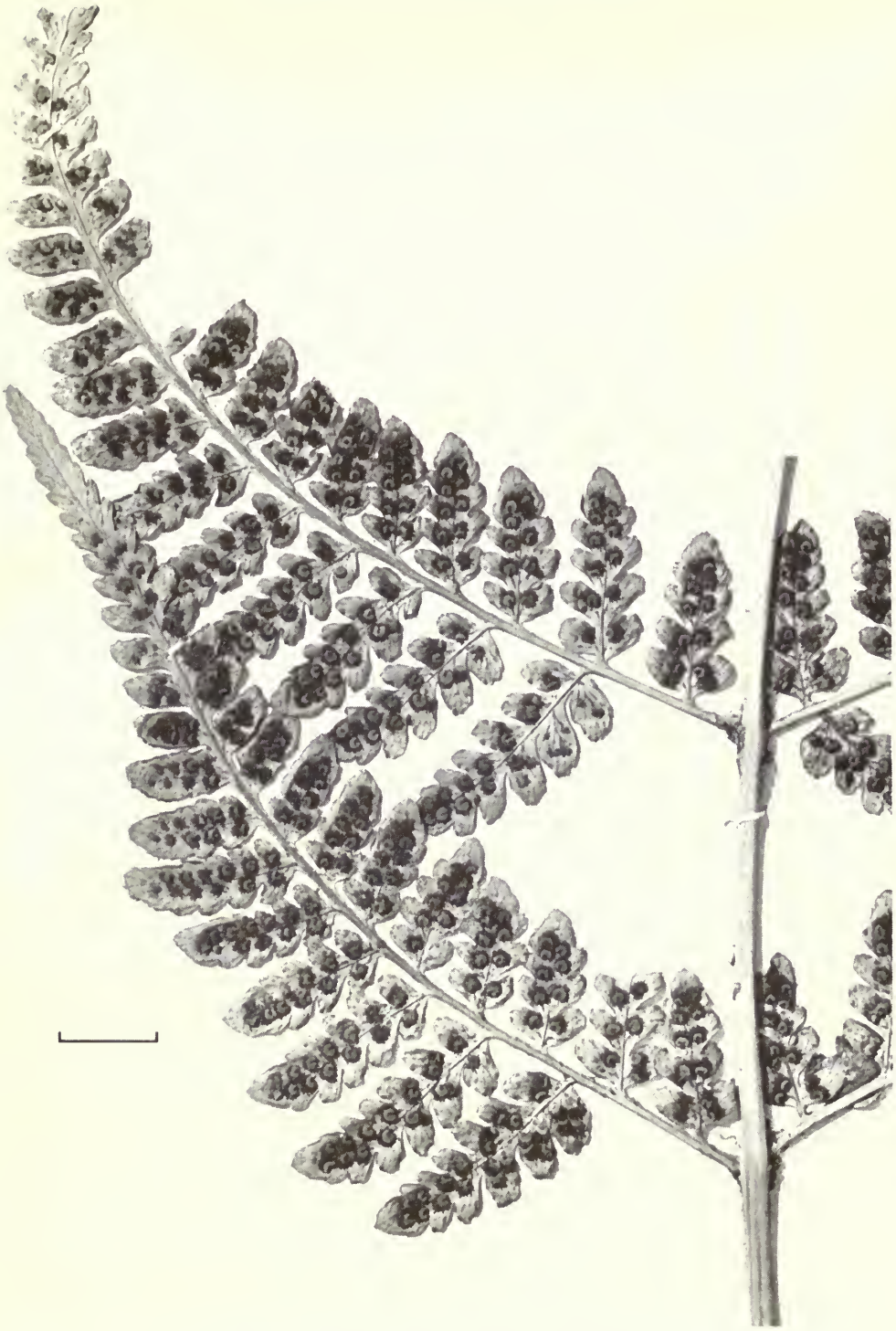

Fig. 72 *Dryopteris* × *ghatakii* (= *D. austro-indica* × *D. cochleata*). India, Madras [= Tamil Nadu], Salem District, Shevaroy Hills, beside Archidia Estate, near Kakasholai, 1 September 1964, *J. Ghatak* G730 (K – holotype). Scale line = 1 cm.

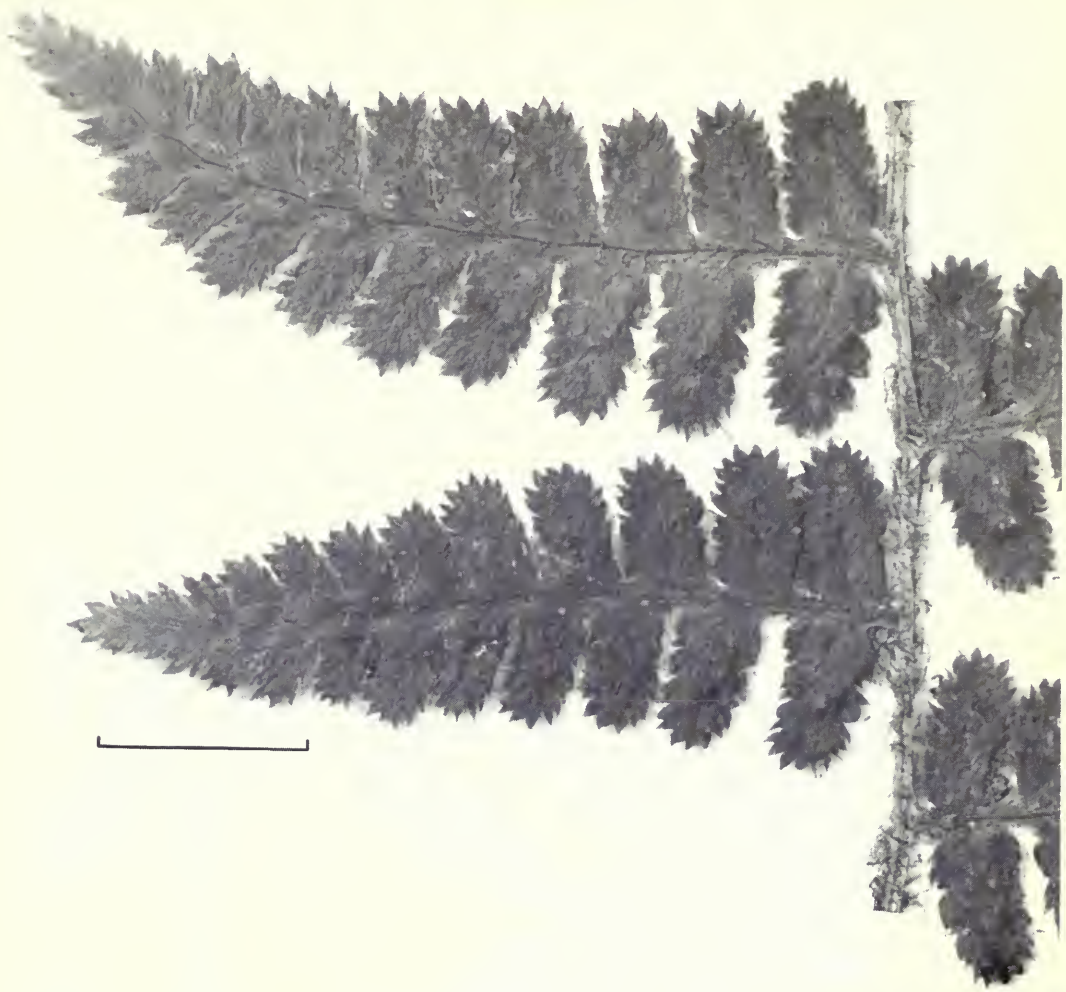

Fig. 73 *Dryopteris* × *liddarensis* (= *D. barbigera* subsp. *barbigera* × *D. serrato-dentata*). India, Kashmir, Liddar valley, north-east of Pahlgam, east side of upper Chatponsal Nullah, near Bajipath, 21 August 1978, *C. R. Fraser-Jenkins* 7519 (BM – holotype). Scale line = 1 cm.

4. Dryopteris × loyalii Fraser-Jenkins, **hybr. nov.** **Fig. 74**
(= *D. caroli-hopei* × *D. marginata*).

Planta in morphologia inter *D. caroli-hopei* et *D. marginatam* intermedia. Segmenta ultima frondis rectangularia ut in *D. marginata*, sed valde dentata ut in *D. caroli-hopei*. Textura laminae inter *D. marginatam* et *D. caroli-hopei* intermedia. Sporae abortivae. Type: N. India, Meghalaya, Khasi Hills, south of Shillong, north of Cherrapunji, 9½ miles west of Umtyngar, 1½ km north of Sohrarim, 1800 m, large ravine by stream in forest, 1 December 1978, *C. R. Fraser-Jenkins* 8976 (BM! – holotype; FR!, G! – isotypes).

Intermediate in morphology between its parents. Stipe scales slightly glossy and sticking out from the stipe. Ultimate frond segments ± rectangular as in *D. marginata*, but well-toothed as in *D. caroli-hopei*. Top surface of the lamina neither as smooth as in *D. marginata*, nor as matt as in *D. caroli-hopei*, and recognisably intermediate in the field. Spores abortive.

Cytology: Unknown.

Fig. 74 *Dryopteris* × *loyalii* (= *D. caroli-hopei* × *D. marginata*). India, Meghalaya, Khasi Hills, south of Shillong, north of Cherrapunji, 1½ km north of Sohrarim, 1 December 1978, *C. R. Fraser-Jenkins* 8976 (BM – holotype). Scale line = 1 cm.

Range: N. India.

Range in the Indian subcontinent: **83** As above.

Notes: Known only from the single collection detailed above, but could occur elsewhere in the east Himalaya. As well as the parental species, the following were growing in the vicinity: *Dryopteris sparsa, D. stenolepis*, and *D. subtriangularis*. This hybrid is of interest as it underlines the biological distinctness of the two parents, for long treated as one species. It is named after Professor D. S. Loyal of Panjab University, Chandigarh, who has laid down much of the groundwork for the study of Himalayan *Dryopteris*.

5. Dryopteris × macdonellii Fraser-Jenkins, **hybr. nov.** **Fig. 75**
(= *D. filix-mas* × *D. ramosa*).

Planta in morphologia inter *D. filix-mas* et *D. ramosam* intermedia. Stipes longus, paleas valde magnas latasque impolitas pallidi-brunneas ad basem ferens. Lamina base aliquantum lata. Pinnulae parum longae margine incisae, lobis acutis, ad apicem gradatim acutae. Sporae abortivae. Type: India, Kashmir, Donari, 7000 ft (2130 m), February 1894, *J. C. McDonell* (K! – holotype).

Intermediate in morphology between its parents, with a long stipe bearing markedly large, wide basal scales, which are matt and pale brown in colour, some of those at the base having a vaguely defined, darker central basal region. Lamina large, with a ± wide base, pinnae widest in their middle; pinnules somewhat long and incised at the sides, with ± pointed lobes and the sides sloping towards the acutely pointed pinnule-apices. Spores abortive.

Cytology: Unknown.

Range: N. India.

Range in the Indian subcontinent: **25** As above.

Notes: Known only from McDonell's collection, but could occur elsewhere in the west

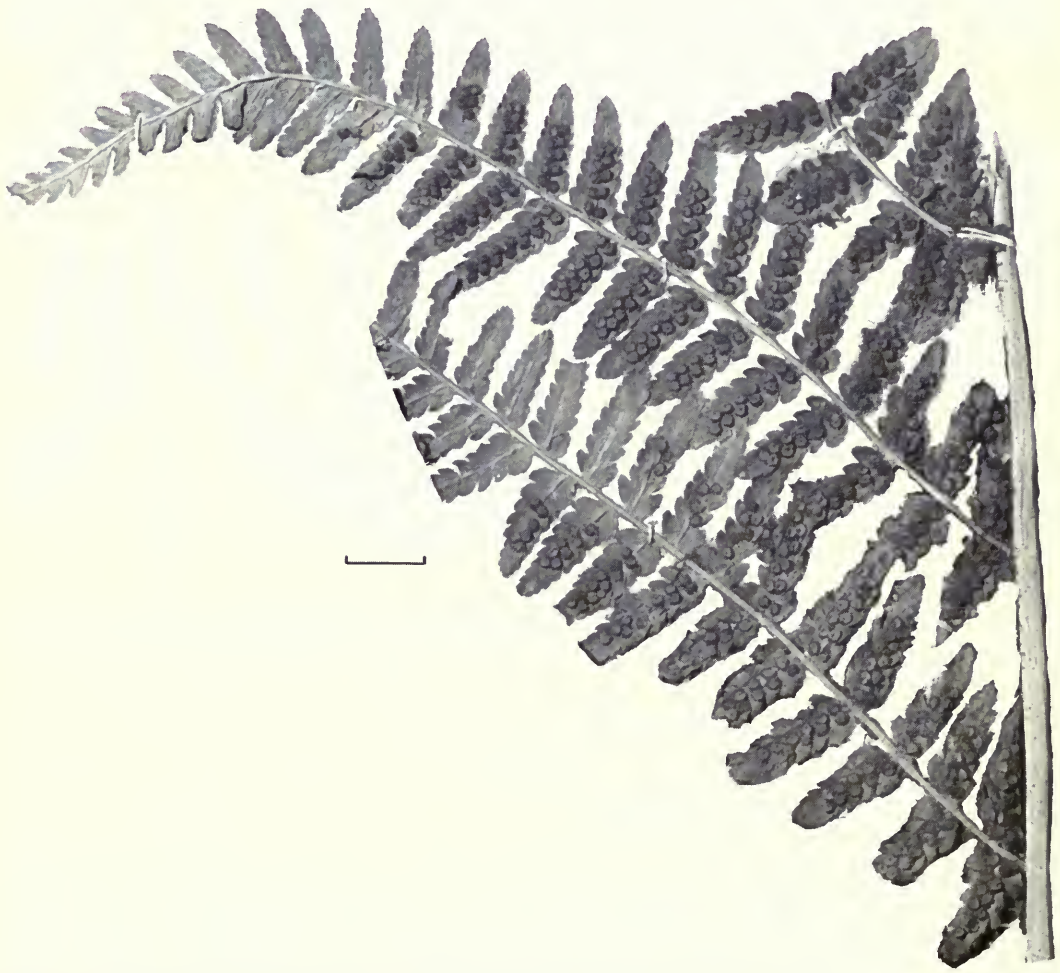

Fig. 75 *Dryopteris* × *macdonellii* (= *D. filix-mas* × *D. ramosa*). India, Kashmir, Donari, February 1894, *J. C. McDonell* (K – holotype). Scale line = 1 cm.

Himalaya. McDonell also collected *Dryopteris ramosa* and *D. blanfordii* subsp. *blanfordii* at Donari, and in addition, *D. filix-mas, D. stewartii,* and *D. nigropaleacea* probably occur in the vicinity. Large, well-developed plants of *D. blanfordii*, which may occasionally have unusually pale scales, can appear to be similar to *D.* × *macdonellii*, but the pinnules are not usually so coarsely incised, the basal pinnules are longer and more deeply incised, and the spores are mostly good when ripe.

This hybrid is named after its collector, J. C. McDonell of Mussoorie, who made extensive collections at the end of the last century.

6. Dryopteris sparsa (2x) × **D. sparsa** (4x) **Fig. 76**

This hybrid is not named as the parents are not separated at specific rank and the whole, ± cryptic complex requires further investigation. Details are given under *D. sparsa*.

Range: N. India.

Range in the Indian subcontinent: **64** Lebong Forest, Darjeeling, 2 August 1958, *D. S. Loyal* (PAN!).

Notes: Reported by Loyal in Mehra (1961) and Mehra & Loyal (1965). Further specimens have been collected by the present author from the same locality (8625 (BM!), 8635 (FR!), and 8641

Fig. 76 *Dryopteris sparsa* (2x) × *D. sparsa* (4x). India, West Bengal, Darjeeling, Lebong, 19 November 1978, *C. R. Fraser-Jenkins* 8641 (H). Scale line = 1 cm.

(H!)). Although Mehra & Loyal (1965) mention that its morphology is intermediate between the more narrowly segmented diploid and more obtusely segmented tetraploid plants, the present author has not found the situation to be so clear, and there appears to be a complete range of morphological variation even after the hybrids have been eliminated by microscopic examination of the spores. It is recognisable by its abortive spores and hybrid vigour.

7. Dryopteris × vidyae Fraser-Jenkins, **hybr. nov.** **Fig. 77**
(= *D. sparsa* × *D. splendens*)

Planta in morphologia inter *D. sparsam* et *D. splendentem* intermedia. Stipes crassus longus niger, paleis brunneis adpressis basi vestitus; rhachis nigra; pinnulae inferiorae basiscopicae longae, eis inferis profunde lobatis. Sporae abortivae. Type: India, Sikkim, Rungji, 6500 ft (1980 m), 14 September 1875, *G. King* 4710 (CAL! – holotype).

Intermediate in morphology between its parents though generally similar to *D. splendens*. Stipe thick, long and black, bearing adpressed, mid-brown scales near the base; rachis black. Lamina ovate-lanceolate and widest shortly above the ± wide base. Differing from *D. splendens* in its lower pinnules being developed and deeply lobed, and longest at the base on the basiscopic side of the lowest pinnae, with sloping sides and narrow, ± pointed apices. Spores abortive.

Cytology: Unknown.

Range: N. India.

Range in the Indian subcontinent: **65** As above.

Notes: Known only from the single collection detailed above, but could occur elsewhere in the east Himalaya. Somewhat similar to the south-east Asian species, *Dryopteris platypus* (Kunze) Kuntze, which, however, does not have such a dark stipe, and has more dissect pinnae and a thinner lamina, and produces good spores.

This hybrid is named after Mrs Vidya Laxmi Gurung of the Department of Medical Plants and Herbs, Kathmandu, who has prepared valuable lists of Nepalese ferns.

8. Dryopteris × wechteriana Fraser-Jenkins, **hybr. nov.** **Fig. 78**
(= *D. chrysocoma* × *D. nigropaleacea*).

Planta in morphologia inter *D. chrysocomam* et *D. nigropaleaceam* intermedia. Stipes longus, paleas latas pallidas prope basem ferens, interdum basi leviter fuscior; pinnulae lobatae, dentes parvos plus minusve acutos ferentes. Sori magni conferti, indusia ad marginem primo inflexa postea elevata. Sporae abortivae. Type: Ex hort. Chelsea Physic Garden, London, July 1981, *C. R. Fraser-Jenkins* 10431 [Original collection from N. India, Himachal Pradesh, 8 km above and east of Simla on Narkanda road, 2450 m, 6 September 1977, *C. R. Fraser-Jenkins* 6948 (BM!)] (BM! – holotype). Merotype: *C. R. Fraser-Jenkins* 9417, ex hort. Chelsea Physic Garden, May 1979 (BM!).

Similar to *Dryopteris chrysocoma*, but differing in having a long stipe with wide, ± pale scales near the base, often with vaguely defined, slightly darker central areas. Lamina slightly wider at the base than in *D. chrysocoma* and pinnules with shallow side lobes and somewhat prominent, small, wide-based teeth with ± acute apices around the pinnule apices. Indusia large, crowded, tall and inflected at the edges, but lifting and shrivelling somewhat. Spores abortive.

Cytology: Diploid (W. Himalaya: Gibby (1985)).

Range: N. India.

Range in the Indian subcontinent: **37** As above.

Notes: Known only from the single specimen detailed above, but could occur elsewhere in the west Himalaya. As well as the parental species, *Dryopteris caroli-hopei* was growing in the vicinity.

This hybrid is named after Dr Richard Wechter, recently of Woodstock School, Mussoorie, and a keen amateur botanist.

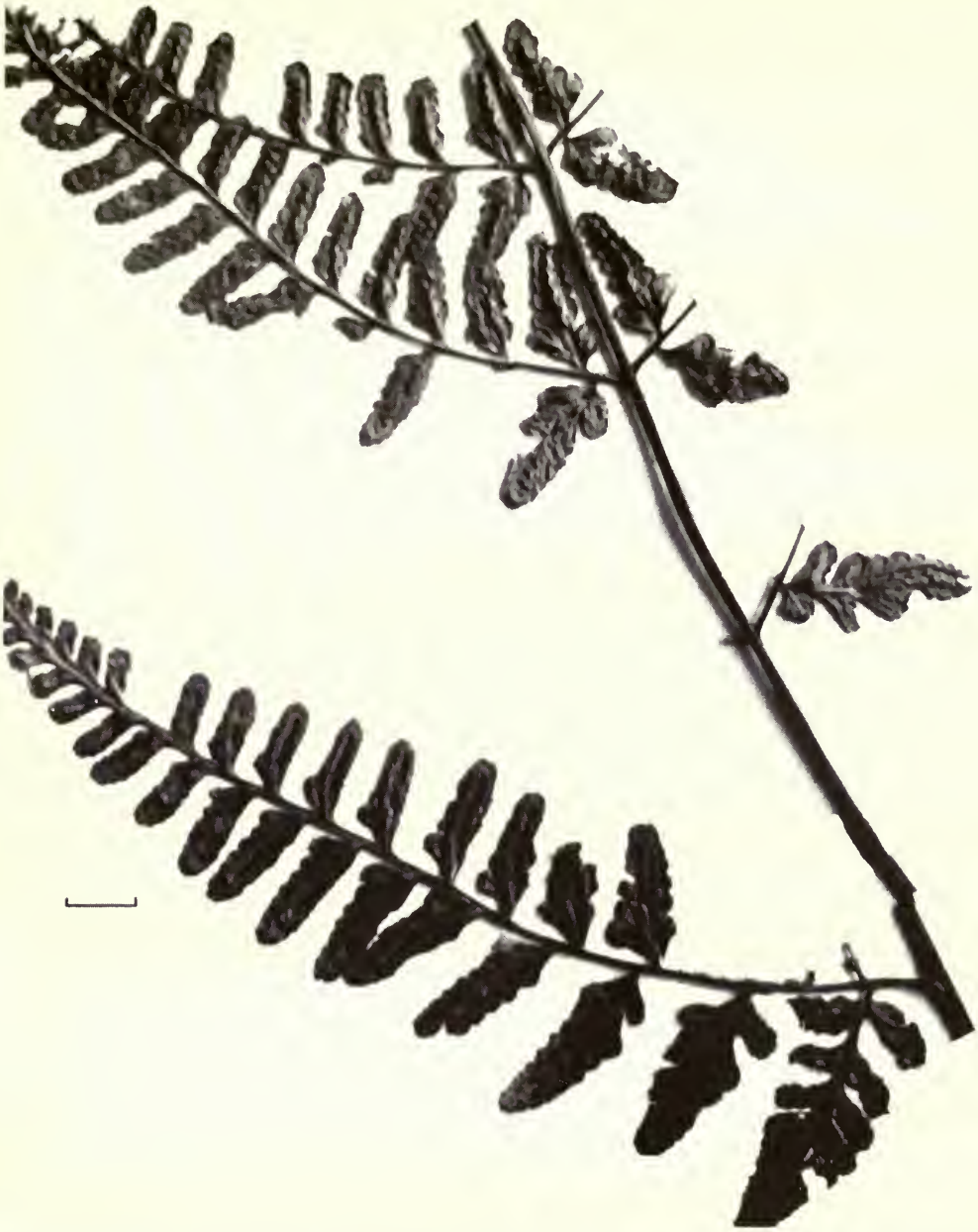

Fig. 77 *Dryopteris* × *vidyae* (= *D. sparsa* × *D. splendens*). India, Sikkim, Rungji, 14 September 1875, *G. King* 4710 (CAL – holotype). Scale line = 1 cm.

9. Dryopteris × zygo-parentalis Fraser-Jenkins, **hybr. nov.** **Fig. 79**
(= *D. darjeelingensis* × *D. scottii*).

Planta in morphologia inter *D. darjeelingensis* et *D. scottii* intermedia. Pinnae aliquantum angustiorae lobis parum rectangularioribus quam illae *D. scottii*. Sori exindusiati; sporae plerumque abortivae. Cytotypus pentaploideus. Type: Ex hort. Chelsea Physic Garden, London, 10 February 1982, *C. R. Fraser-Jenkins* 10858 [Original collection from N. India, W. Bengal, south-west of Darjeeling, Manebhan-

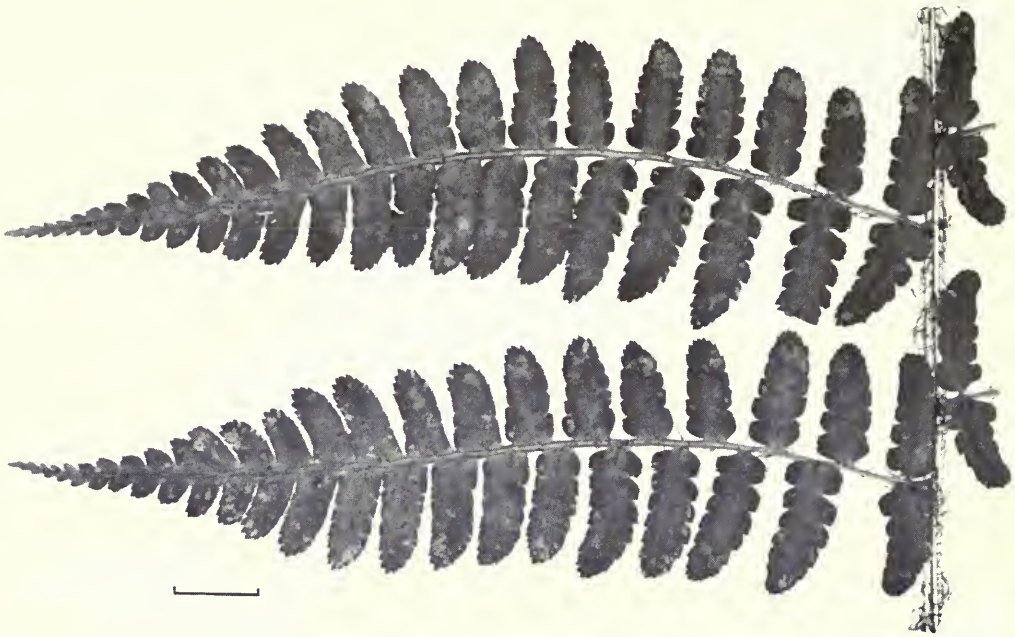

Fig. 78 *Dryopteris* × *wechteriana* (= *D. chrysocoma* × *D. nigropaleacea*). India, Himachal Pradesh, Simla, 6 September 1977, *C. R. Fraser-Jenkins* 6948 (BM – holotype). Scale line = 1 cm.

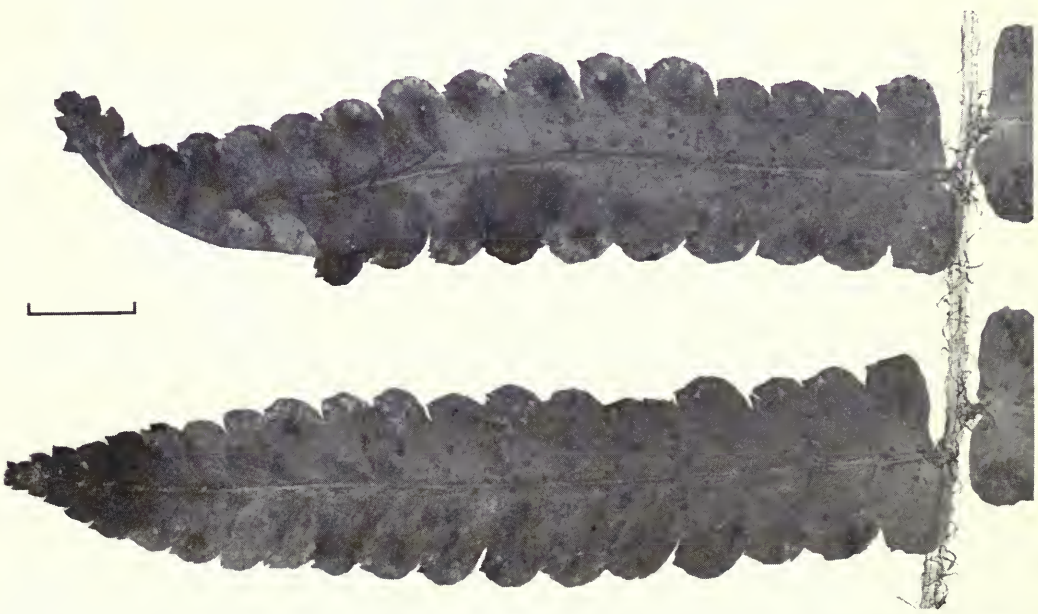

Fig. 79 *Dryopteris* × *zygo-parentalis* (= *D. darjeelingensis* × *D. scottii*). Ex hort. Chelsea Physic Garden, London, 10 February 1982, *C. R. Fraser-Jenkins* 10858 (BM – holotype). Scale line = 1 cm.

jang to Sukia Pokhri, *c.* 2200 m, forest, 16 November 1978, *C. R. Fraser-Jenkins* 8577 (BM!)] (BM! – holotype).

Similar to *Dryopteris scottii*, but differing in its slightly narrower pinnae with slightly more rectangular lobes. Sori exindusiate; spores mostly abortive, though some large, good ones also occur. It is emphasised that this hybrid can only be reliably recognised by its abortive spores.

Cytology: Pentaploid (E. Himalaya: Gibby (1985)).

Range: N. India (E. Himalaya in the Sikkim area).

Range in the Indian subcontinent: **64** As above.

Notes: Known only from the single specimen detailed above. It was found in a mixed population containing mostly *Dryopteris darjeelingensis*, with a few plants of *D. scottii*, and was not known certainly to be a hybrid until Gibby's cytological investigation, due to the young state of the original specimen.

Excluded taxa

Various species have been reported fairly recently from the Himalaya, but are not present, being European (in the wide sense) or eastern Asian in distribution; some others, widely reported as *Dryopteris*, belong to other genera.

Dryopteris aemula (Aiton) Kuntze
Reported, sub *Polypodium aemulum*, from the mountains north of Rohilkund by Clarke in Roxburgh's *Flora Indica* (1874), in error for *Hypodematium crenatum* (Forsskal) Kuhn (see Morton, 1974).

Dryopteris apiciflora (Wallich ex Mett.) Kuntze, **D. clarkei** (Baker) Kuntze, and **Nephrodium nidus** C. B. Clarke, though superficially similar to *Dryopteris* section *Fibrillosae*, all belong to the ctenitoid genus *Dryopsis* (formerly placed in *Ctenitis*) as *D. apiciflora* (Wallich ex Mett.) Holttum & Edwardes, *D. clarkei* (Baker) Holttum & Edwardes, and *D. nidus* (C. B. Clarke) Holttum & Edwardes. The ctenitoid hairs sticking up from the upper surface of the lamina can hardly fail to be observed, particularly when seen in the living state.

Dryopteris brunoniana (Wallich ex Mett.) Kuntze
As pointed out by Ching (1938) this species is an *Athyrium*, to which he gave the name *Athyrium wallichianum*, the epithet *brunonianum* having already been used in the combination *A. brunonianum* Milde.

Dryopteris carthusiana (Villars) H. P. Fuchs
Reported occasionally in herbaria from the west Himalaya, in error for *D. ramosa*. Beddome's (1870, 1892) original report of this species (sub *Lastrea spinulosa*) was based on a genuine specimen of *D. carthusiana*, labelled 'Himalaya. coll. Jerdon. ?Kashmir' (K!) and annotated by Beddome. However, the origin of this specimen was certainly European, and the species is not known from the Indian subcontinent.

Dryopteris decipiens (Hook.) Kuntze
Reported from the Parasnath Hills by Roy & Pandey in Fabbri (1963). The author has been unable to obtain any confirmation of the record from Roy or Pandey, but it is almost certainly an error, and presumably refers to a non-dryopteroid fern.

Dryopteris dilatata (Hoffm.) A. Gray
This record is based on a specimen mounted on the same sheet as the above-mentioned specimen of *D. carthusiana* (K!). It is a specimen of this European species, labelled in error as being from Kashmir. The presence of two European species on the same sheet confirms the European origin of the specimens.

Dryopteris gracilis (T. Moore ex Beddome) Ching
This was stated by Ching (1938) to be a *Dryopteris* species, in contrast to Clarke's (1880) view that it was a *Polystichum* (sub *Aspidium*). However, some confusion must have occurred as the type specimens (K!) are merely small specimens of *Polystichum thomsonii* (Hook. f.) Beddome, as was pointed out by Christensen (1906). A specimen at Kew, annotated by Ching as being *Dryopteris gracilis*, is *Dryopsis nidus* (C. B. Clarke) Holttum & Edwardes.

Dryopteris hendersonii (Beddome) C. Chr. and **D. squamiseta** (Hook.) Kuntze have both been transferred by Ching (1966) to *Nothoperanema*, where they properly belong.

Dryopteris pallida (Bory) C. Chr. ex Maire & Petitm.
Reported occasionally from the west Himalaya in error for *D. nigropaleacea* and/or possibly *D. juxtaposita*.

Dryopteris yunnanensis (Christ) Copel.
This species (synonyms: *D. elongata* (J. Smith) Kuntze, non (Aiton) T. Sim, *D. khasiana* C. Chr., and *Microchlaena yunnanensis* (Christ) Ching) is an athyrioid fern and should be known as *Kuniwatsukia cuspidata* (Beddome) Pichi Serm. Tagawa & Iwatsuki (1960) confuse it with *Dryopteris* subgenus *Pycnopteris*.

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